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Rural-Urban Disparities in Quality of Life Among Patients With COPD

Bradford E. Jackson, PhD[1], **David B. Coultas, MD**[2], **Sumihiro Suzuki, PhD**[3], **Karan P. Singh, PhD**[1], and **Sejong Bae, PhD**[1]

[1]Division of Preventive Medicine, Department of Medicine, University of Alabama at Birmingham, Birmingham Alabama 35205

[2]Department of Medicine, University of Texas Health Science Center at Tyler, Tyler, Texas

[3]Department of Biostatistics, School of Public Health, University of North Texas Health Science Center, Fort Worth, Texas

Abstract

Purpose—Limited evidence in the US suggests that among patients with chronic obstructive pulmonary disease (COPD), rural residence is associated with higher hospitalization rates and increased mortality. However, little is known about the reasons for these disparities. This study's purpose was to describe the health status of rural vs urban residence among patients with COPD and to examine factors associated with differences between these 2 locations.

Methods—This was a cross-sectional study of baseline data from a representative sample of patients with COPD enrolled in a clinical trial. Rural-urban residence was determined from zip code. Health status was measured using the SF-12 and health care utilization. Independent sample *t*-tests, chi-square tests, and multiple linear and logistic regressions were performed to examine differences between rural and urban patients.

Findings—Rural residence was associated with poorer health status and higher health care utilization. Among rural patients unadjusted physical functioning scores were lower on the SF-12 (30.22 vs 33.49; $P = .005$) that persisted after adjustment for potential confounders ($\beta = -2.35$; $P = .04$). However, after further adjustment for social and psychological factors only the Body-Mass index, Airflow obstruction, Dyspnea, and Exercise (BODE) Index was significantly associated with health status.

Conclusions—In this representative sample of patients with COPD rural residence was associated with worse health status, primarily associated with greater impairment as measured by BODE index. While rural patients reported a higher dose of smoking, a number of other unmeasured factors associated with rural residence may contribute to these disparities.

Keywords

COPD; health disparities; health-related quality of life; rural; utilization of health services

For further information, contact: Bradford Jackson, PhD; Division of Preventive Medicine; 1717 11th Ave. South MT 401W; Birmingham, AL 35205; beaj@uab.edu. .

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Preliminary findings from this study were presented as a poster at the European Respiratory Society Annual Congress, Amsterdam, 2011.

Examination of geographic variation in disease occurrence and other disease measures provides a method for detection of gaps in quality of public health activities and clinical health care services.[1] Moreover, regional variations in health care costs and outcomes have focused attention on the need and opportunity for improvements in delivery of health care in the US.[2] These analyses have largely been conducted using administrative databases of specific populations including Medicare,[3] Medicaid, Veterans Administration[4,5] (VA), and hospitals.[6]

Regional and system-level variation for a number of chronic obstructive pulmonary disease (COPD)-related measures has been found in the US and worldwide. The populations studied in the US have largely included health and hospital systems with variations found in use of diagnostic spirometry,[7] health status,[8] exacerbation/hospitalization rates,[3,4,9-12] quality of care,[6] and mortality.[13] Of these studies 2 have focused on rural-urban differences in mortality in the VA[13] and hospitalization rates among Texas hospitals.[10,11] While these studies provide evidence for substantial variation in a number of outcomes, limited evidence is available on factors to explain these regional variations.

In Texas, Jackson et al. found higher rates of hospitalization for COPD in non-metropolitan counties[11] Regional differences in the distribution of racial and ethnic groups, and indices of regional isolation including concentration of non-metropolitan counties, hospitals, and pulmonary specialists were all associated with higher hospitalization rates.[10] However, this analysis was limited because of inherent limitations of administrative data, which lacks data on clinical characteristics and other potential determinants of health outcomes. To further examine reasons for these regional differences in COPD hospitalization rates we used detailed patient-specific data from a clinical trial to examine the relationships between rural vs urban residence location and outcomes including patient-reported health status and health care utilization among patients with COPD.

METHODS

Study Design and Population

Patients were recruited from clinics of the University of Texas Health Science Center-Tyler, located in a region with a large rural population.[14] Patients > 45 years of age with physician-diagnosed COPD were recruited as part of a clinical trial[15] using 2 methods: provider referrals and patient registry using the International Classification of Disease 9th revision (ICD-9) codes 491, 492, and 496 with standardized eligibility criteria (Table 1). The Institutional Review Board of the University of Texas Health Science Center approved the study (IRB# 855).

Measurements

Data collected at baseline for the trial were used in this analysis. The data components included demographics, clinical characteristics, and health status. Specific data items were chosen based upon well-established determinants of health outcomes among patients with COPD. Rural-urban status was classified according to Rural Urban Commuting Area codes,[16] a census tract-level scheme that is based on the Bureau of Census Urbanized Area and Urban Cluster definitions.

Clinical characteristics known to affect health outcomes included smoking status, severity of impairment, co-morbid illnesses, medication adherence, activation level, and self-efficacy. Smoking status included current, former, and never; and total pack-years. Severity of impairment was measured with spirometry, BODE (body mass index, airflow obstruction, dyspnea, and exercise capacity) Index,[17] and Chronic Respiratory Questionnaire-SA (CRQ).[18-20] Spirometry and 6-minute walk (6MW) were conducted according to American

Thoracic Society criteria.[21,22] Severity of spirometric impairment was classified using the global initiative for chronic obstructive lung disease (GOLD) criteria.[23] Co-morbid conditions were measured using the Charlson co-morbidity index (CCI).[24] Depressive symptoms[25] were measured with the Geriatric Depression Scale (GDS).[26] Medication adherence was defined according to severity of Forced Expiratory Volume in 1 second (FEV_1) impairment.[27] Standardized instruments were used to measure level of patient activation[28] and COPD self-efficacy.[29]

Health Outcomes

Health outcomes included SF-12 physical and mental component scores (PCS and MCS) and self-reported health care utilization in the past 6 months.[30-33] Self-reports of health care utilization were assessed for lung and non-lung-related reasons comprising visits to a physician, nurse, nurse practitioner, or physician assistant; hospitalizations; visits to urgent care or emergency room; and use of home health services.

Statistical Analysis

Frequencies and means (± SD) were used to summarize categorical and continuous variables, respectively. Rural-urban comparisons were conducted using independent samples *t*-tests, Mann-Whitney U test, and chi-square tests.

Two regression models were constructed to examine independent effect of residence on SF-12 adjusting for confounders. In the regression models, SF-12 PCS and MCS were the dependent variables, and rural-urban classification was the primary explanatory variable. The first model consisted of rural-urban residence, age, gender, race, smoking status, pack-years, GOLD stage, 6MW classification, GDS score, and BODE index. To examine differences in health status independent of social, psychological, co-morbidity, and management factors the second model further adjusted for marital status, education, income, CCI, medication adherence, level of activation, and self-efficacy. The variables chosen *a priori* for inclusion in the models were based on literature review.

Logistic regressions were performed to determine the odds of health care utilization adjusting for gender, race, smoking status, 6MW, BODE index, and CCI. These variables were included to account for exacerbation proclivity, exercise capacity, COPD specific severity, and general disease complexity. Results were considered statistically significant at the 0.05 level. Analysis was performed using SAS v.9.3 (SAS Institute Inc., Cary, North Carolina).

RESULTS

Patient Characteristics

Of 217 patients enrolled, 50.7% were rural residents. The average age of the entire sample was 68 years, with 50.2% female and 91.2% Non-Hispanic White (Table 2). Among rural residents there were a number of statistically significant differences compared to urban residents including a higher proportion of males (58.2% vs 41.1%; $P = .015$), greater median number of pack-years (54.0 vs 46.9; $P = .019$), and higher BODE index (4.8 vs 4.1; $P = .013$), indicating more severe impairment. Moreover, the higher BODE index among rural residents was associated with more severe spirometric impairment, higher dyspnea levels, and shorter 6-minute walk distance.

Health Status

Overall, rural residents had worse health status and higher health care utilization compared to urban residents (Table 3). The SF-12 PCS was lower among rural patients (30.2)

compared to urban patients (33.5), which is significantly different statistically ($P = .005$) and clinically. The minimal clinically important difference in PCS and MCS is 3 and 3.5, respectively.[30,34] However, there were no observed rural-urban differences in MCS.

For health care utilization, rural residents reported a higher prevalence of service use (Table 3). However, outpatient visits for lung disease was the only service use that was statistically different (80.0% vs 68.2%; $P = .05$). Other utilization of services that were higher but not statistically different among rural residents compared to urban residents were outpatient visits for non-lung diseases, hospitalizations for lung diseases, and urgent care or emergency room visits for lung disease.

Multivariable Models

Multiple linear regression was used to examine the independent effect of rural residence on health status measured by SF-12 PCS and MCS (Table 4). Model 1 consisted of rural-urban status as the primary explanatory variable adjusting for age, gender, race, smoking status, pack-years, GDS score, GOLD stage, 6MW classification, and BODE index. Model 2 comprised all of the variables in model 1, but it also adjusted for marital status, education, income, CCI, medication adherence, level of activation, and self-efficacy.

Rural residents had a predicted SF-12 PCS that was 2.38 points lower than urban residents after adjusting for age, gender, race, smoking status, and GOLD stage (Table 4, Model 1). This difference was statistically significant but did not meet the minimal clinically important difference threshold of 3. After further adjustment for other covariates in Model 2, only BODE index continued to be significantly associated with PCS. For the BODE index, a 1-point increase was associated with a 1.8 decrease in PCS. The adjusted R^2 was 0.24 for Model 1 and 0.26 for Model 2, suggesting that the additional variables in Model 2 provided little to further explain the variation in the data.

While there were no statistically or clinically significant differences between rural and urban residents for SF-12 MCS in Models 1 or 2, there were a number of other factors associated with the MCS (Table 4). These factors included smoking status, depressive symptoms, and self-efficacy. The adjusted R^2 was 0.32 for Model 1 and 0.43 for Model 2, suggesting that the addition of self-efficacy and measures of social support such as marital status and education may be important measures contributing to the variation in MCS.

Multiple logistic regression was used to examine the independent effect of rural residence on health care utilization (Table 5). After adjusting for gender, race, smoking status, 6MW classification, BODE index, and CCI there were positive associations for lung-related utilization, but there were no statistically significant differences in utilization between the 2 groups.

DISCUSSION

In this sample of patients with COPD we found that rural residence was associated with poorer health status and higher levels of utilization of selected health care services compared to urban residents. However, after adjustment for multiple determinants of health status and health care utilization, rural residence was not independently associated with either outcome. The major factor associated with poorer health status was greater severity of physical impairment as measured by BODE index. In contrast, factors associated with mental health (ie, MCS) were largely demographic, social, self-efficacy, and psychological factors.

The relationship between residence location and health status is complex and not consistent, with a number of factors that may contribute to the inconsistency including variations in

lifestyle, environmental and occupational exposures, and differences in access to health care.[35] The higher number of pack-years of smoking among our sample of rural residents suggests that longer duration of smoking may have contributed to greater impairment of lung function. While we did not collect data on exposures other than smoking, rural residence may be associated with exposures to other environmental and occupational risk factors for COPD such as fuel-fired power plants[36] and agricultural work.[37-39]

Differences between rural and urban residence in health care needs and access to health care may result from variations in population characteristics, in the number of physicians and other health care providers, in the quality of health care delivery, and in the distributions of persons with health insurance. Rural communities are heterogeneous, differing in population density, remoteness from urban areas, and economic and social characteristics.[40] Because rural communities have a higher proportion of older residents, there is a higher demand for health care services for chronic conditions. Moreover, in the US the majority of rural counties are designated as physician shortage areas.[41] While evidence regarding health care quality in rural areas is sparse,[40] delay in diagnosis may result from underutilization of spirometry among patients with COPD, which varies regionally.[7] Health insurance is a major determinant of access to health care and while nearly all patients in our sample had health insurance because of age and disability (data not shown), rural residents may not have had health insurance at younger ages,[42] which may have limited access to preventive services and delayed diagnosis and treatment until impairment and disease were more advanced.

Results of our investigation of rural-urban differences with detailed clinical information may help explain previous findings using administrative data of increased hospitalizations and mortality among patients with COPD.[10,13] In Texas, using 2007 hospital discharge data, Jackson et al[10] found that a higher level of rurality (ie, lower concentration of hospitals and pulmonary specialists) was associated with higher hospitalization rates. Similarly, higher mortality among veterans living in isolated rural areas was described by Abrams and colleagues.[13] These higher rates of hospitalization and mortality associated with rural residence may be partly explained by the higher dose of smoking and greater severity of impairment found among rural residents in our study population.

Several limitations must be considered in the interpretation of the findings. The results should be generalized with caution because the data were collected at a single center. However, the patients were enrolled from both primary and specialty care and represent a broad spectrum of patients with COPD. Moreover, because this is a cross-sectional study, causal inferences cannot be established between rural residence, disease severity, and health status. However, in previous longitudinal studies, BODE index has been associated with increased hospitalization and mortality.[17,43] Residence location was limited to current residence, which may have resulted in misclassification and underestimation of the effects of rural residence. Finally, the power to detect differences in selected components of health care utilization may have been limited by the small number of occurrences.

In conclusion, these results add to the growing literature on geographic disparities among patients with COPD and provide evidence that partly explains the higher hospitalization rates for patients with COPD in rural areas of Texas[11] and other areas of the southern US.[3] Moreover, the finding of greater severity of impairment as measured by the BODE index emphasizes the need for effective interventions targeting rural communities to prevent these disparities.[44]

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REFERENCES

1. Radley DC, Schoen C. Geographic variation in access to care--the relationship with quality. N Engl J Med. 2012; 367(1):3–6. [PubMed: 22693955]
2. The Dartmouth Institute. [Accessed August 14, 2012] Dartmouth Atlas of Health Care. Available from:http://www.dartmouthatlas.org/
3. Holt JB, Zhang X, Presley-Cantrell L, Croft JB. Geographic disparities in chronic obstructive pulmonary disease (COPD) hospitalization among Medicare beneficiaries in the United States. Int J Chron Obstruct Pulmon Dis. 2011; 6:321–328. [PubMed: 21697996]
4. Priest JL, Cantrell CR, Fincham J, Cook CL, Bursch SP. Quality of care associated with common chronic diseases in a 9-state Medicaid population utilizing claims data: an evaluation of medication and health care use and costs. Popul Health Manag. 2011; 14(1):43–54. [PubMed: 21142926]
5. Sommers BD, Baicker K, Epstein AM. Mortality and Access to Care among Adults after State Medicaid Expansions. N Engl J Med. 2012; 367(11):1025–1034. [PubMed: 22830435]
6. Lindenauer PK, Pekow P, Gao S, Crawford AS, Gutierrez B, Benjamin EM. Quality of care for patients hospitalized for acute exacerbations of chronic obstructive pulmonary disease. Ann Intern Med. 2006; 144(12):894–903. [PubMed: 16785478]
7. Joo MJ, Lee TA, Weiss KB. Geographic variation of spirometry use in newly diagnosed COPD. Chest. 2008; 134(1):38–45. [PubMed: 18347201]
8. Fan VS, Bridevaux PO, McDonell MB, Fihn SD, Besser LM, Au DH. Regional variation in health status among chronic obstructive pulmonary disease patients. Respiration. 2011; 81(1):9–17. [PubMed: 20720400]
9. Lipton R, Banerjee A. The geography of chronic obstructive pulmonary disease across time: California in 1993 and 1999. Int J Med Sci. 2007; 4(4):179–189. [PubMed: 17664956]
10. Jackson BE, Suzuki S, Coultas D, et al. Safety-net facilities and hospitalization rates of chronic obstructive pulmonary disease: a cross-sectional analysis of the 2007 Texas Health Care Information Council inpatient data. Int J Chron Obstruct Pulmon Dis. 2011; 6:563–571. [PubMed: 22135489]
11. Jackson BE, Suzuki S, Lo K, et al. Geographic disparity in COPD hospitalization rates among the Texas population. Respir Med. 2011; 105(5):734–739. [PubMed: 21255991]
12. Joo MJ, Lee TA, Weiss KB. Geographic variation in chronic obstructive pulmonary disease exacerbation rates. J Gen Intern Med. 2007; 22(11):1560–1565. [PubMed: 17874272]
13. Abrams TE, Vaughan-Sarrazin M, Fan VS, Kaboli PJ. Geographic isolation and the risk for chronic obstructive pulmonary disease-related mortality: a cohort study. Ann Intern Med. 2011; 155(2):80–86. [PubMed: 21768581]
14. Texas Association of Counties County Information Project. [Accessed August 11, 2012] Texas County Profiles. Available from: http://www.txcip.org/tac/census/CountyProfiles.php
15. [Accessed December 14, 2012] Randomized Trial of Physical Activity Self-Management Intervention for Patients with COPD (COPD-SMART). ClinicalTrials.govAvailable from: http://www.clinicaltrials.gov/ct2/show/NCT01108991?term=COPD+and+texas&rank=2
16. United States Department of Agriculture. [cited on July 5 2012Accessed July 5, 2012] Rural-Urban Commuting Area Codes. Available from: http://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes.aspx
17. Celli B, Cote CG, Marin JM, et al. The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. N Engl J Med. 2004; 350(10): 1005–1012. [PubMed: 14999112]
18. Schunemann HJ, Griffith L, Jaeschke R, et al. A comparison of the original chronic respiratory questionnaire with a standardized version. Chest. 2003; 124(4):1421–1429. [PubMed: 14555575]

19. Schunemann HJ, Puhan M, Goldstein R, Jaeschke R, Guyatt GH. Measurement properties and interpretability of the Chronic respiratory disease questionnaire (CRQ). COPD. 2005; 2(1):81–89. [PubMed: 17136967]
20. Guyatt GH, Berman LB, Townsend M, Puglsey SO, Chambers LW. A measure of quality of life for clinical trials in chronic lung disease. Thorax. 1987; 42(10):773–778. [PubMed: 3321537]
21. ATS Committee on Proficiency Standards for Clincal Pulmonary Function Laboratories. ATS statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002; 166(1):111–117. [PubMed: 12091180]
22. Miller MR, Hankinson J, Brusasco V, et al. Standardisation of spirometry. Eur Respir J. 2005; 26(2):319–338. [PubMed: 16055882]
23. Pauwels RA, Buist AS, Ma P, Jenkins CR, Hurd SS. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: National Heart, Lung, and Blood Institute and World Health Organization Global Initiative for Chronic Obstructive Lung Disease (GOLD): executive summary. Respir Care. 2001; 46:798–825. [PubMed: 11463370]
24. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis. 1987; 40(5):373–383. [PubMed: 3558716]
25. Omachi TA, Katz PP, Yelin EH, et al. Depression and health-related quality of life in chronic obstructive pulmonary disease. Am J Med. 2009; 122(8):778e9–15. [PubMed: 19635280]
26. Friedman B, Heisel MJ, Delavan RL. Psychometric properties of the 15-item geriatric depression scale in functionally impaired, cognitively intact, community-dwelling elderly primary care patients. J Am Geriatr Soc. 2005; 53(9):1570–1576. [PubMed: 16137289]
27. Qaseem A, Wilt TJ, Weinberger SE, et al. Diagnosis and management of stable chronic obstructive pulmonary disease: a clinical practice guideline update from the American College of Physicians, American College of Chest Physicians, American Thoracic Society, and European Respiratory Society. Ann Intern Med. 2011; 155(3):179–191. [PubMed: 21810710]
28. Heller A, Elliot MN, Haviland AM, Klein DJ, Kanouse DE. Patient activation status as a predictor of patient experience among Medicare beneficiaries. Med Care. 2009; 47(8):850–857. [PubMed: 19584763]
29. Wigal JK, Creer TL, Kotses H. The COPD Self-Efficacy Scale. Chest. 1991; 99(5):1193–1196. [PubMed: 2019177]
30. Jones PW, Brusselle G, Dal Negro RW, et al. Health-related quality of life in patients by COPD severity within primary care in Europe. Respir Med. 2011; 105(1):57–66. [PubMed: 20932736]
31. Ware, JKM.; Keller, S. SF-12: How to score the SF-12 Physical and Mental Health Summary Scores. The Health Institute, New England Medical Center; Boston, MA: 1995.
32. Ritter PL, Stewart AL, Kaymaz H, Sobel DS, Bock DA, Lorig KR. Self-reports of health care utilization compared to provider records. J Clin Epidemiol. 2001; 54(2):136–141. [PubMed: 11166528]
33. Coultas D, Frederick J, Barnett B, Singh G, Wludyka P. A randomized trial of two types of nurse-assisted home care for patients with COPD. Chest. 2005; 128(4):2017–2024. [PubMed: 16236850]
34. Ware, JKM.; Turner-Bowker, DM.; Gandek, B. User's Manual for the SF-12 Health Survey. Quality Metric Incorporated; Lincoln, RI: 2002.
35. Teckle P, Hannaford P, Sutton M. Is the health of people living in rural areas different from those in cities? Evidence from routine data linked with the Scottish Health Survey. BMC Health Serv Res. 2012; 12:43. [PubMed: 22340710]
36. Liu XL, Lessner L, Carpenter DO. Association between residential proximity to fuel-fired power plants and hospitalization rate for respiratory diseases. Environ Health Perspect. 2012; 120(6): 807–810. [PubMed: 22370087]
37. Greskevitch M, Kullman G, Bang KM, Mazurek JM. Respiratory disease in agricultural workers: mortality and morbidity statistics. J Agromedicine. 2007; 12(3):5–10. [PubMed: 19042666]
38. Lamprecht B, Schirnohofer L, Kaiser B, Studnicak M, Buist AS. Farming and the prevalence of non-reversible airways obstruction: results from a population-based study. Am J Ind Med. 2007; 50(6):421–426. [PubMed: 17497693]

39. Respiratory health hazards in agriculture. Am J Respir Crit Care Med. 1998; 158(5 Pt 2):S1–S76. [PubMed: 9817727]

40. Institutes of Medicine. Quality Through Collaboration: The Future of Rural Health. Washington, DC: 2005.

41. Texas Department of State Health Services. [Accessed August 8, 2012] Federally Designated Primary Care Health Professional Shortage Areas 2011. Available from:http://www.dshs.state.tx.us/chs/hprc/hpsa.shtm

42. Hunsaker M, Kantayya VS. Building a sustainable rural health system in the era of health reform. Dis Mon. 2010; 56(12):698–705. [PubMed: 21168576]

43. Cote CG, Celli BR. Pulmonary rehabilitation and the BODE index in COPD. Eur Respir J. 2005; 26(4):630–636. [PubMed: 16204593]

44. Linderman DJ, Koff PB, Freitag TJ, Min SJ, Vandivier RW. Effect of integrated care on advanced chronic obstructive pulmonary disease in high-mortality rural areas. Arch Intern Med. 2011; 171(22):2059–2061. [PubMed: 22158579]

Table 1

Inclusion and Exclusion Criteria for Patients Interviewed With COPD

Inclusion	Exclusion
Age ≥ 45 years	Participation in pulmonary rehabilitation program with 12 months
physician diagnosis of COPD FEV_1/FVC<70% and FEV1<70%	Nursing home resident Uncontrolled hypertension, angina, heart failure
MMRC dyspnea score ≥ 2	Unstable EKG findings (eg, uncontrolled dysrhythmia, active ischemia)
	Dementia, uncontrolled psychiatric illness
	Life expectancy < 12 months
	Resting oxygen saturation < 90% and inability to obtain supplemental oxygen
	6 minute walk < 110 m
	Other safety concerns with participating in physical activity

FEV_1=forced expiratory volume in one second, FVC=forced vital capacity, MMRC=modified Medical Research Council

Table 2

Demographic and Health Characteristics of Rural and Urban COPD Patients

Variables	Rural (n=110)		Urban (n=107)		*P*
Age (years), mean (SD)	67.9	(10.14)	68.19	(9.18)	.822
Gender, n(%)					
Male	64	(58.18)	44	(41.12)	.015 [a]
Female	46	(41.82)	63	(58.88)	
Race/Ethnicity, n(%)					
Hispanic	1	(0.91)	2	(1.87)	.152
NH White	105	(95.45)	93	(86.92)	
NH Black	4	(3.64)	11	(10.28)	
NH Other	0	(0)	1	(0.93)	
Insurance status (n,%)[b]					
Medicare	89	(80.91)	86	(80.37)	.591
Medicaid	20	(18.19)	15	(14.01)	.553
Private/Other	49	(44.56)	48	(44.86)	.769
Uninsured	6	(5.45)	7	(6.54)	.736
Smoking Status, n(%)					
Current Smoker	27	(24.55)	24	(22.43)	.907
Ex-Smoker	73	(66.36)	74	(69.16)	
Never smoker	10	(9.09)	9	(8.41)	
Pack-Years, Mean(SD)	64	(36.7)	54.7	(36.2)	.077
Pack-Years, median(IQR)	54	(40.0, 82.0)	46.9	(31.2, 65.1)	.019 [a]
Currently using oxygen, n(%)					
Yes	50	(45.45)	38	(35.51)	.136
No	60	(54.55)	69	(64.49)	
Medication Adherent, n(%)	15	(13.64)	8	(7.55)	.141
Charlson comorbidity index, mean(SD)	2.87	(1.95)	3.03	(2.02)	.563
Activation Level, n(%)					
Active	55	(50.00)	57	(53.27)	.592
High effort	15	(13.64)	11	(10.28)	
Complacent	33	(30.00)	28	(26.17)	
Passive	7	(6.36)	11	(10.28)	
Geriatric Depression Scale					
No Depression	82	(74.55)	78	(72.90)	.783
Depression	28	(25.45)	29	(27.10)	
Self Efficacy					
Negative Affect	2.54	(0.93)	2.52	(0.85)	.907
Emotional Arousal	2.38	(0.84)	2.38	(0.79)	.983
Physical Exertion	3.03	(0.99)	2.97	(0.92)	.600
Weather/Environment	2.76	(0.84)	2.75	(0.83)	.965
Behavior	2.76	(0.95)	2.64	(0.89)	.320

[a] Indicates statistical significance at the 0.05 level

[b] Levels of insurance status are not mutually exclusive; patients may have multiple providers, therefore the total is not equal to 217; percentages are out of the total 217 subjects

P values are based on independent sample t-tests, chi-square tests, and Mann Whitney U test

SD=Standard Deviation; IQR=Interquartile range; NH=Non hispanic

Table 3

Clinical Measurements and Health Care Utilization of Rural and Urban COPD Patients

Variables	Rural (n=110)		Urban (n=107)		*P*
BODE index, mean(SD)	4.75	(1.87)	4.10	(1.92)	.013 [a]
Body Mass Index	28.92	(6.84)	28.97	(6.62)	.946
FEV1%	44.24	(13.29)	47.40	(12.9)	.077
MRC dyspnea scale	2.02	(0.89)	1.68	(0.96)	.008 [a]
6MWD(m)	334.0	(99.26)	352.3	(94.00)	.164
6MWD(m), median(IQR)	345.40	(253.1, 396.5)	366.0	(291.3, 427.0)	.215
Chronic Respiratory Questionnaire, mean(SD)					
Dyspnea	4.27	(1.31)	4.46	(1.34)	.284
Fatigue	3.60	(1.07)	3.72	(1.31)	.619
Emotional Functioning	4.51	(0.88)	4.54	(0.91)	.829
Mastery	4.28	(0.79)	4.31	(0.72)	.745
GOLD Stage, n(%)					
Stage II: Moderate	43	(39.09)	54	(50.47)	.217
Stage III: Severe	48	(43.64)	40	(37.38)	
Stage IV: Very Severe	19	(17.27)	13	(12.15)	
SF-12, mean(SD)					
PCS	30.22	(8.32)	33.49	(8.72)	.005 [a]
MCS	51.09	(11.63)	49.09	(11.14)	.198
Health Care Utilization n(%)					
1.) Visited a physician/nurse/nurse practitioner/physician assistant for Lung disease.	88	(80.00)	73	(68.22)	.048 [a]
2.) Visited a physician/nurse/nurse practitioner/physician assistant's visits for non-lung disease.	80	(72.73)	71	(66.98)	.357
3.) Hospitalized for lung disease.	20	(18.18)	13	(12.15)	.216
4.) Hospitalized for health problems other than lung disease.	8	(7.27)	10	(9.35)	.579
5.) Visited an urgent care or emergency room for lung disease and were not hospitalized.	9	(8.18)	7	(6.54)	.644
6.) Visited an urgent care or emergency room for health problems other than lung disease and were not hospitalized.	13	(11.82)	16	(14.95)	.497
7.) Used any home health services.	12	(10.91)	12	(11.21)	.943

[a] indicates statistical significance at the 0.05 level

P values are based on independent sample *t*-tests and chi-square tests

SD=Standard Deviation; PCS=Physical Composite Score; MCS=Mental Composite Score; 6MWD=6 minute walk distance GOLD=Global Initiative for Chronic Obstructive Lung Disease; MRC=Medical Research Council

Table 4

Association of Rural-Urban Status With Quality of Life as Measured by the SF-12

Health Outcome	SF-12 Physical Composite Score		SF-12 Mental Composite Score	
Variables	**Model 1[b]**	**Model 2[c]**	**Model 1[b]**	**Model 2[c]**
Rural(ref=Urban)	−2.38 [a]	−2.30	0.45	0.85
Age	0.06	0.05	0.16	0.17
Female (ref=Male)	−0.10	0.43	−0.93	−0.29
Smoker (ref=Ex/Never)	−0.56	−0.13	3.72 [a]	3.69 [a]
Pack-Years	0.02	0.02	0.01	0.02
Depression(ref=No depression)	−2.74	−2.04	−13.8 [a]	−9.73 [a]
GOLD stage 3/4 (ref=stage 2)	1.72	0.95	0.38	−0.49
6MW (ref=< 350m)	2.61	2.99	−2.07	−1.53
BODE index	−1.80 [a]	−1.35 [a]	−0.19	0.04
marital status		1.37		−0.30
education		−0.08		−2.68
income		1.63		1.38
Charlson comorbidity index		−0.52		0.17
Medication adherence		0.05		1.50
Level of Activation		0.33		0.47
Negative Affect		0.95		−3.89 [a]
Emotional Arousal		1.24		−2.02
Physical Exertion		−1.73		−1.72
Weather		−0.96		7.19 [a]
Behavior		−0.51		−1.78

[a] indicates $P<0.05$

[b] Model 1 adjusted for Urbanicity, Age, gender, race, smoking status, pack-years of smoking, GOLD stage, and 6MW

[c] Model 2 further adjusts for marital status, income, CCI, Medication adherence, level of activation, and COPD self efficacy

6MW=6 minute walk; BODE=Body mass index, FEV1, dyspnea, and exercise capacity

Table 5

Odds Ratios for the Adjusted Relationships for Health Care Utilization

	Physician Visits for Lung Disease 95%			**Hospitalized for Lung Disease 95%**			**ER Visits for Lung Disease 95%**		
Variables	**OR**	**LCL**	**95%UCL**	**OR**	**LCL**	**95%UCL**	**OR**	**LCL**	**95%UCL**
Rural(ref=Urban)	1.87	0.84	3.42	1.55	0.65	3.71	1.10	0.37	3.28
Female(ref=Male)	0.83	0.40	1.69	1.53	0.65	3.61	0.84	0.29	2.44
Smoker(ref=Ex/Never)	0.46	0.20	1.04	1.43	0.51	4.01	1.59	0.48	5.27
6MW(ref=< 350m)	2.36	0.98	5.71	0.18[a]	0.06	0.58	0.66	0.18	2.44
BODE Index	1.63[a]	1.27	2.09	1.14	0.88	1.49	1.07	0.76	1.52
CCI	1.33a	1.04	1.69	1.13	0.94	1.36	1.24	1.02	1.52

	Physician visits for non Lung Disease 95%			Hospitalized for non Lung Disease 95%			ER visits for non Lung disease 95%		
Variables	OR	LCL	95%UCL	OR	LCL	95%UCL	OR	LCL	95%UCL
Rural(ref=Urban)	1.33	0.70	2.55	0.64	0.22	1.82	1.14	0.47	2.77
Female(ref=Male)	0.87	0.46	1.65	1.17	0.42	3.24	3.80[a]	1.44	10.01
Smoker(ref=Ex/Never)	0.76	0.36	1.58	1.20	0.38	3.83	2.45	0.96	6.24
6MW(ref=LT 350m)	0.95	0.44	2.05	2.15	0.59	7.87	0.74[a]	0.25	2.16
BODE Index	0.98	0.80	1.20	1.40[a]	1.00	1.97	0.71[a]	0.52	0.96
CCI	1.16	0.96	1.40	1.16	0.95	1.42	1.23	0.99	1.51

	Used any Home Health Services 95%		
Variables	OR	LCL	95%UCL
Rural(ref=Urban)	1.35	0.51	3.57
Female(ref=Male)	1.60	0.62	4.17
Smoker(ref=Ex/Never)	1.10	0.36	3.37
6MW(ref=LT 350m)	0.38	0.11	1.26
BODE Index	1.01	0.75	1.37
CCI	1.37[a]	1.13	1.66

[a]indicates statistical significance, $P<0.05$

The model adjusts for Urbanicity, age, gender, race, smoking status, 6 minute walk distance, BODE index, and Charlson comorbidity index
6MW=6 minute walk; CCI=Charlson co-morbidity index; ER=Emergency room; OR=Odds Ratio; LCL=Lower confidence limit; UCL=Upper confidence limit