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Alcohol use disorder and healthcare utilization in patients with chronic asthma and obstructive lung disease

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Abstract

Alcohol use disorder (AUD) is associated with significant direct morbidity and mortality. The impact of alcohol on chronic asthma and obstructive lung disease is unknown. AUD treatment may represent a potential target to improve healthcare utilization and healthcare costs in this patient population.

Utilizing data from the 2012–2015 National Readmissions Database (NRD), and National Emergency Department Sample (NEDS) patients with a diagnosis of asthma or COPD were identified. Documented substance misuse, rates of hospitalization, frequency of hospital readmission, markers of admission severity and cost were assessed.

Within the NEDS cohort, 2,048,380 patients with a diagnosis of COPD or asthma were identified. Patients with documented AUD were more likely to present with respiratory failure (OR 1.32 (1.26, 1.39) $p < 0.001$) and more likely to require mechanical ventilation in the emergency room. (OR 1.30 [1.19, 1.42], $p<0.001$). Within the NRD cohort 1,096,663 hospital admissions were identified. AUD was documented in 4.1%. AUD was associated with an increased length of stay (OR 1.06 (1.04, 1.08) $p <0.001$), increased hospitalization cost and an increased likelihood of 30 day readmission (OR 1.24 (1.2, 1.28) $p <0.001$).

AUD is associated with increased disease morbidity and healthcare utilization in patients with asthma or COPD. This impact persists after adjusting for substance misuse, and associated comorbidities. Identifying and treating AUD in this patient population may improve disease, patient and health-system outcomes.

Keywords

Chronic obstructive asthma; alcohol use disorder; healthcare utilization

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Introduction:

Alcohol use disorder (AUD) affects up to 8.5% of the US population, and is directly associated with an increased risk of death from accident, injury and suicide.[1–4] Utilization of AUD treatment however remains low. Only 7% of patients with documented AUD will receive treatment over a lifetime.[1] In addition to the direct harms of AUD, at a population level, AUD is associated with an increased risk of a number of chronic disease states, including chronic lung disease. [5–7]

Animal studies suggest that chronic alcohol use may be associated with disruption of the pulmonary epithelium, and has been associated with an increased risk of death from infectious pulmonary disease, presumed to be related to impaired immunity. [8–12] Alcohol has previously been suggested as a potential trigger for worsening asthma symptoms within a subset of patients, though data to support this conclusion is mixed.[13–15] In specific sub-populations of patients with COPD, co-existing AUD has been associated with an increased risk of 30 day readmission. [16,178,9] Single center data suggests that AUD may have a significant impact on chronic lung disease outcomes·[7] However, the full extent of this impact in both the inpatient and emergency room setting has yet to be quantified on a national scale. The cost associated with increased healthcare utilization due to AUD in these conditions is also unknown.

Reducing the burden of chronic lung disease has proven challenging. Hospital readmission and emergency room utilization for asthma and COPD remain high- impacting both the individual patient, and the healthcare system as a whole·[18–20] Misdiagnosis of asthma and COPD is common, particularly in patients with historical tobacco misuse and limited access to primary care.[21] Additionally, asthma-COPD overlap syndromes are increasingly recognized, particularly in patients with tobacco use.[4] Given this, studies utilizing electronic medical record data who limit their sample to a diagnosis of asthma alone may fail to capture a subset of patients at highest risk for negative healthcare outcomes.

AUD may impact outcomes in asthma and COPD, either directly through the action of alcohol on the lung itself, or indirectly by impacting access to care. If so, identification and treatment of AUD in patients with asthma and COPD could represent a potential target for improving chronic disease outcomes. We aim to quantify both the financial and clinical impact of AUD in patients with asthma and COPD across the United States.

Methods.

Data Description.

This study utilizes data from the 2012 to 2015 Nationwide Readmissions Database (NRD), and the 2012 to 2015 Nationwide Emergency Department Sample (NEDS). The NRD and NEDS contain de-identified data collated from 27 states across the United States. Through these datasets, hospitalization data, emergency room utilization and readmission frequency can be obtained for an individual patient across the calendar year.[16]

International Classification of Diseases, Ninth and Tenth Revision, Clinical Modification (ICD-9-CM and ICD-10 CM) codes were used to identify patients with COPD or asthma with and without documented AUD during their hospitalization or emergency room presentation (Supplemental Table One). Documented history of other substance use including tobacco, opiates, amphetamines, benzodiazepines, marijuana, cocaine, 'non-specific' drug use or 'other mixed' drug use was also collected (Supplemental Table Two).

The Elixhauser comorbidity index was calculated using the Elixhauser Comorbidity Software; this score was modified to exclude alcohol and substance misuse as these are part of our exposure of interest.22 The HCUP Cost-to-Charge Ratio (CCR) Files were used to translate reported hospital charges into actual costs.[23] Costs were then inflated to 2015 USD using the Gross Domestic Product (GDP) price index.[24]

Analytic Sample.

All adult subjects (18 years or older) with a primary diagnosis of asthma or COPD were included in the analysis. Subjects were excluded if they had a secondary diagnosis of pulmonary conditions due to fumes and vapors, cystic fibrosis, pulmonary circulation disorders and or idiopathic pulmonary fibrosis. The index admission was the first admission during a particular year with a primary diagnosis of asthma or COPD. To assess 30-day readmissions, subjects who died in the hospital during the index admission (n=9,596) and those discharged during the month of December (n=93,708) were excluded. Due to the known frequency of misdiagnosis of both COPD and asthma, we chose to combine both diagnoses into a single cohort of patients rather than analyzing each syndrome separately.[21,25] Sensitivity analysis was performed for key outcomes by asthma, COPD and the combined diagnosis group.

Missing data.—Data were missing for the following variables: median household income national quartile (1.6%), total charges/costs (1.2%), patient location (0.29%), primary expected payer (0.17%), in-hospital death (0.03%), length of stay (0.006%), total charges for ED services (15.4%), median household income national quartile (2.2%), patient status at discharge from ED or, if admitted, inpatient stay (1.4%), patient location (0.60%), primary expected payer (0.11%), and gender (0.003%). Amongst those admitted to the same hospital, the following inpatient related variables had missing values: total charges for ED and inpatient services (0.73%) and disposition from inpatient stay (0.028%).

Statistical Analysis.—Analyses were performed according to published HCUP analytic guidelines using the SURVEY procedures in SAS 9.4 software (SAS Institute, Cary, NC).26 Descriptive statistics, including means, percentages and standard errors were computed with analytic sample weights. Unadjusted comparison of subjects with AUD vs. those without was done using t-tests for continuous factors and Rao-Scott chi-square tests for categorical variables.

Weighted regression analysis was used to determine the impact of AUD on morbidity and mortality. Weighted logistic regression was used for binary outcomes (ventilation, respiratory failure, sepsis, shock, AKI, encephalopathy, stroke, in-hospital death, and 30-day readmission); weighted odds ratios with 95% confidence intervals are presented. Continuous

outcomes (DRG, length of stay and costs) were analyzed using weighted linear regression. Length of stay and costs were log-transformed and the exponential of the model parameters and corresponding 95% confidence interval are presented. All models included drug misuse, tobacco use disorder, age, gender, primary expected payer, median household income national quartile per zip code, patient location, hospital location, rehabilitation transfer involved, AIDS, deficiency anemias, rheumatoid arthritis/collagen vascular diseases, chronic blood loss anemia, congestive heart failure, coagulopathy, depression, diabetes, hypertension, hypothyroidism, liver disease, lymphoma, fluid and electrolyte disorders, metastatic cancer, other neurological disorders, obesity, paralysis, peripheral vascular disorders, psychoses, renal failure, solid tumor without metastasis, peptic ulcer disease excluding bleeding, valvular disease and weight loss. All tests were two-tailed and performed at a significance level of 0.05.

Results

Emergency Room

Utilizing the NEDS database a total of 2,048,380 patients presenting to the Emergency Room with a diagnosis of asthma or COPD were identified (Table One).[21,25] Of these, 2.11% had a documented alcohol misuse during their emergency room presentation (n= 40, 967). On average, patients with documented AUD were likely to be older than those without documented AUD (58.1 versus 53.7, $P < 0.001$). They were also significantly more likely to be male (69.5% versus 40%).

Among patients with documented AUD, 63.1% had documented tobacco use. Associated substance misuse was also relatively common, with 7,158 (0.34%) patients having both documented alcohol and substance misuse.

During their ER admission, patients with documented alcohol use were more likely to have documented respiratory failure (OR 1.32 (1.26, 1.39) $p < 0.001$), and were at increased risk of need for mechanical ventilation on arrival (OR 1.30 (1.19, 1.42) $p<0.001$) (Table Two). They were also more likely to present with encephalopathy on their initial admission (OR: 1.83 (1.54, 2.17) $p<0.001$).

Documented alcohol use was associated with a significant increase in risk of admission to the hospital from the ER (OR: 2.39 (2.27, 2.50) $p <0.001$). Despite the increased severity in presentation, AUD was also associated with an increased risk of leaving against medical advice from the emergency room (OR: 1.17 (1.07, 1.28) $p<0.001$).

Inpatient admissions

Utilizing the NRD database a total 1,096,663 hospital admissions for a primary diagnosis of COPD or asthma were identified over the three year study period. 4.1% (4.1, 4.2) had documented AUD in addition to their primary pulmonary diagnosis. Documentation of AUD was most common in patients with documented COPD (4.77%) and lowest in those with documented asthma alone (2.77%).

Compared to patients without documented AUD, patients with AUD were younger by an average of 4 years (61.1 versus 65.6, p<0.001). They were significantly more likely to be male, and were more likely to use tobacco at time of presentation (66.9% vs 30.1%, p <0.001) (Table Three). Patients with documented AUD were more likely to self-pay or receive hospital level financial assistance during their hospitalization (OR 2.29, CI: 2.2194 to 2.3711, P <0.001). Despite being younger than patients without documented AUD, average modified Elixhauser comorbidity index was increased within this cohort (12.8 versus 12.0, P < 0.001).

AUD was associated with an increased risk of negative outcomes during hospitalization. Across diagnosis groups, AUD was associated with an increased risk of need for mechanical ventilation, with the highest risk seen in those with asthma-COPD overlap (OR 1.58 (1.15, 2.18) P <0.005) (Table Four). An association between documented AUD and risk of encephalopathy (OR 1.7 (1.5, 1.9) p <0.001) and stroke (OR 1.6 (1.1, 2.2) p <0.012) was also seen.

Compared to patients without documented substance misuse, documented alcohol use was associated with a small but significant increase in length of stay. (OR 1.06 (1.04, 1.08) p <0.001). A significant increase in initial admission cost was also noted ($8,328.40 vs $7,723.04, P<0.001). This increase in admission costs persisted across all diagnosis codes during sensitivity analysis, though was highest in the COPD-asthma overlap group ($7184.43 versus $6706.1, P<0.005). Documented AUD was also associated with a significant risk of 30 day readmission across all diagnosis groups (OR 1.24 (1.2, 1.28) p <0.001).

Discussion

In patients with asthma or COPD, AUD is associated with increased disease related morbidity, increased healthcare utilization and increased healthcare costs. This impact persists after adjusting for the increased rates of tobacco use, substance misuse and chronic disease seen within this cohort.

Within the emergency room setting, patients with asthma or COPD and documented AUD were more likely to require hospital admission, despite also being more likely to leave against medical advice. In the inpatient setting patients with asthma or COPD and documented AUD were more likely to require mechanical ventilator support, and were more likely to be readmitted in the 30 days following their initial readmission.

While the association between AUD and negative healthcare outcomes for patients with asthma or COPD has not been previously reported, the finding that AUD is associated with increased healthcare utilization and morbidity is in keeping with the existing literature. Rehm et. al previously identified a significant association between AUD and risk of alcohol attributable disease related mortality, as well as increased risk of hospitalization for alcohol related disease across a French cohort, though did not assess the impact of AUD on chronic lung disease.[6] Wu et. Al. found that AUD was associated with an increased risk of hospitalization across multiple chronic disease states, including COPD.[7] Our study expands

on this finding. In patients with chronic lung disease, AUD is associated not only with an increased risk of hospitalization, but with an increased risk of in-hospital morbidity, readmission and increased healthcare cost.

Whether this increased risk of negative outcomes is due to a physiologic impact of alcohol on the lungs themselves, or whether these outcomes are an indirect feature of the direct harms of alcohol use cannot be determined from our data alone. AUD and at risk alcohol consumption have previously been shown to impact treatment adherence across a number of chronic disease states.[27–29] Given the increased risk of uninsured status within the AUD cohort and the increase in average modified-Elixhauser comorbidity index seen in patients with documented AUD, we suspect that these findings seen within our study are most likely attributable to the impact of AUD on access to care, access to treatment and treatment adherence, though further work is needed to determine the true etiology.

We know that AUD is significantly under-documented, and in many cases unrecognized by physicians. Given our study is based on NIS data, it is likely that the true burden of AUD is under-reported within our sample. Additionally, while we comment on the impact of documented AUD, our ability to comment on the impact of different patterns of problem drinking including binge drinking is limited.

Even with these limitations, patients with combined chronic lung disease and AUD appear to be at increased risk of admission and subsequent readmission compared to those with chronic obstructive lung disease alone. They represent a previously unidentified subset of at risk patients, who may benefit from a combined therapeutic approach. Identifying and treating AUD in this high risk patient population could potentially improve patient outcomes, and decrease inappropriate care utilization.

Conclusion

Alcohol use disorder is associated with a significantly increased risk of negative healthcare outcomes in patients with a diagnosis of asthma or COPD While the causality of this remains unclear, AUD appears to significantly increase risk for hospitalization, readmission and negative healthcare outcomes in patients with asthma or COPD. The healthcare cost associated with this increased risk is significant. Patients with co-existing obstructive lung disease and AUD represent a high risk group, who have the potential to benefit from targeting, combined treatment approaches, decreasing healthcare cost and improving individual patient outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table one:

Characteristics of subjects presenting to the emergency department with COPD or asthma

Factor	No Alcohol/Drug misuse	Alcohol Misuse
	(N=1,959,697)	(N=35,810)
Primary diagnosis (95% CI)		
• **Asthma**	53.4 (52.6, 54.2)	25.4 (24.3, 26.5)
• **COPD**	46.6 (45.8, 47.4)	74.6 (73.5, 75.7)
Age in years at admission, mean (95% CI)	53.7 (53.5, 53.9)	58.1 (57.8, 58.3)
Gender, % (95% CI)		
• **Male**	40.0 (39.7, 40.3)	69.5 (68.8, 70.2)
• **Female**	60.0 (59.7, 60.3)	30.5 (29.8, 31.2)
Primary expected payer, % (95% CI)		
• **Medicare**	40.3 (39.7, 40.9)	41.2 (40.3, 42.1)
• **Medicaid**	23.4 (22.8, 24.0)	27.6 (26.7, 28.5)
• **Private insurance**	18.8 (18.4, 19.2)	12.9 (12.3, 13.5)
• **Self-pay**	13.5 (13.0, 14.0)	12.6 (11.9, 13.3)
• **No charge**	0.79 (0.64, 0.94)	1.4 (1.1, 1.7)
• **Other**	3.1 (2.8, 3.4)	4.1 (3.6, 4.5)
• **Unknown**	0.12 (0.09, 0.14)	0.12 (0.04, 0.19)
Patient location, % (95% CI)		
• **Large Central Metro**	28.4 (26.7, 30.1)	28.5 (26.6, 30.5)
• **Large Fringe Metro**	19.7 (18.5, 20.9)	20.1 (18.5, 21.7)
• **Medium Metro**	21.5 (20.1, 22.8)	22.7 (20.9, 24.4)
• **Small Metro**	9.6 (8.6, 10.5)	10.1 (8.8, 11.4)
• **Micropolitan**	12.0 (11.4, 12.5)	10.7 (9.9, 11.5)
• **Noncore**	8.4 (7.9, 8.8)	5.7 (5.2, 6.3)
• **Unknown**	0.51 (0.42, 0.59)	2.2 (1.7, 2.6)
Tobacco use disorder, % (95% CI)	24.0 (23.5, 24.5)	63.1 (62.4, 63.8)

Table two:

AUD in Subjects Presenting to the ED with Asthma and COPD: Associations with Binary Outcomes

	Unadjusted		Adjusted[1]	
Weighted OR (95% CI)	**p-value**	**Weighted OR (95% CI)**	**p-value**	
Mechanical ventilation	3.20 (2.96, 3.46)	<0.001	1.30 (1.19, 1.42)	<0.001
Respiratory failure	2.63 (2.51, 2.76)	<0.001	1.32 (1.26, 1.39)	<0.001
Sepsis	1.85 (1.52, 2.26)	<0.001	0.93 (0.75, 1.16)	0.5
Shock	1.67 (1.23, 2.27)	0.001	0.71 (0.51, 0.99)	0.041
Encephalopathy	3.66 (3.14, 4.27)	<0.001	1.83 (1.54, 2.17)	<0.001
Stroke	1.34 (0.82, 2.18)	0.25	0.99 (0.59, 1.67)	0.97
Admitted to hospital	4.45 (4.25, 4.67)	<0.001	2.39 (2.27, 2.50)	<0.001
Left against medical advice	1.22 (1.12, 1.34)	<0.001	1.17 (1.07, 1.28)	<0.001

Results of weighted logistic regression analysis.

OR: odds ratio; CI: confidence interval; AKI: acute kidney injury

[1]All adjusted ORs are adjusted for tobacco use disorder, age, gender, primary expected payer, median household income national quartile per zip code, patient location, hospital location, rehabilitation transfer involved, AIDS, deficiency anemias, rheumatoid arthritis/collagen vascular diseases, chronic blood loss anemia, congestive heart failure, coagulopathy, depression, diabetes, hypertension, hypothyroidism, liver disease, lymphoma, fluid and electrolyte disorders, metastatic cancer, other neurological disorders, obesity, paralysis, peripheral vascular disorders, psychoses, renal failure, solid tumor without metastasis, peptic ulcer disease excluding bleeding, valvular disease and weight loss.

[2]Adjusted for all factors mentioned above[1] and other individual drug types (alcohol, amphetamine, cannabis, cocaine, opioids, benzodiazepines, non-specific and other/mixed drugs).

Table three:

Characteristics of subjects admitted to hospital with COPD or asthma

Factor	No Alcohol/Drug misuse	Alcohol Misuse Only
	(N=1,002,270)	(N=38,331)
Primary diagnosis (95% CI)		
• **Asthma**	29.8 (29.4, 30.2)	17.1 (16.6, 17.7)
• **COPD**	70.2 (69.8, 70.6)	82.9 (82.3, 83.4)
Age in years at admission, mean (95% CI)	65.6 (65.5, 65.7)	61.1 (61.0, 61.3)
Gender, % (95% CI)		
• **Male**	38.1 (37.9, 38.3)	70.4 (69.8, 70.9)
• **Female**	61.9 (61.7, 62.1)	29.6 (29.1, 30.2)
Primary expected payer, % (95% CI)		
• **Medicare**	64.7 (64.4, 65.1)	49.9 (49.3, 50.5)
• **Medicaid**	12.4 (12.2, 12.7)	20.6 (20.1, 21.2)
• **Private insurance**	14.8 (14.6, 15.1)	14.0 (13.5, 14.5)
• **Self-pay**	4.5 (4.4, 4.7)	9.4 (9.0, 9.9)
• **No charge**	0.67 (0.57, 0.77)	1.6 (1.3, 1.9)
• **Other**	2.6 (2.5, 2.8)	4.2 (3.9, 4.5)
• **Unknown**	0.17 (0.13, 0.21)	0.20 (0.15, 0.26)
Patient location, % (95% CI)		
• **Large Central Metro**	22.9 (21.8, 24.0)	25.3 (23.8, 26.8)
• **Large Fringe Metro**	24.4 (23.3, 25.4)	24.0 (22.7, 25.2)
• **Medium Metro**	19.6 (18.6, 20.7)	20.7 (19.5, 21.9)
• **Small Metro**	9.6 (8.9, 10.3)	10.0 (9.2, 10.9)
• **Micropolitan**	12.6 (12.2, 13.1)	11.0 (10.4, 11.7)
• **Noncore**	10.7 (10.3, 11.1)	7.9 (7.3, 8.4)
• **Unknown**	0.20 (0.17, 0.22)	1.09 (0.94, 1.3)
Tobacco use disorder, % (95% CI)	30.1 (29.9, 30.4)	66.9 (66.4, 67.5)

Table Four:

Sensitivity analysis of key inpatient outcomes for patients with documented asthma, COPD and overlapping asthma/COPD diagnosis codes.

	Asthma Only		**COPD Only**		**Asthma + COPD**	
Unweighted N	309,576		722,786		54,864	
Weighted N	670,396		1,639,721		116,177	
% with documented alcohol misuse (95% CI)	2.77 (2.68, 2.87)		4.77 (4.68, 4.87)		3.46 (3.27, 3.65)	
Binary Outcomes	**Adjusted[1] OR (95% CI)**	**p-value**	**Adjusted[1] OR (95% CI)**	**p-value**	**Adjusted[1] OR (95% CI)**	**p-value**
Intubation/ Mechanical Ventilation	1.22 (1.06, 1.39)	***0.005***	1.20 (1.11, 1.30)	***<0.001***	1.58 (1.15, 2.18)	***0.005***
Respiratory failure	1.02 (0.93, 1.11)	0.73	1.02 (0.97, 1.06)	0.45	1.01 (0.87, 1.18)	0.86
Sepsis	0.90 (0.63, 1.29)	0.57	0.86 (0.72, 1.02)	0.075	0.91 (0.49, 1.68)	0.75
Encephalopathy	1.62 (1.15, 2.29)	***0.006***	1.70 (1.49, 1.95)	***<0.001***	0.82 (0.42, 1.61)	0.56
In hospital mortality	0.75 (0.51, 1.10)	0.14	0.93 (0.82, 1.07)	0.32	0.95 (0.45, 2.01)	0.89
30-day Readmission	1.34 (1.25, 1.44)	***<0.001***	1.18 (1.14, 1.22)	***<0.001***	1.19 (1.01, 1.39)	***0.037***
Costs	**Adjusted[1] Mean (95% CI)**	**p-value**	**Adjusted[1] Mean (95% CI)**	**p-value**	**Adjusted[1] Mean (95% CI)**	**p-value**
Alcohol misuse group	5953.52 (5784.41, 6127.58)	***<0.001***	6910.62 (6779.65, 7044.12)	***<0.001***	7184.43 (6826.29, 7561.36)	***<0.001***
No alcohol misuse group	5615.76 (5491.56, 5742.76)		6486.23 (6379.40, 6594.85)		6706.10 (6442.03, 6980.99)	

1. Adjusted for tobacco use disorder, drug misuse, age, gender, primary expected payer, median household income national quartile per zip code, patient location, hospital location, AIDS, deficiency anemias, rheumatoid arthritis/collagen vascular diseases, chronic blood loss anemia, congestive heart failure, coagulopathy, depression, diabetes, hypertension, hypothyroidism, liver disease, lymphoma, fluid and electrolyte disorders, metastatic cancer, other neurological disorders, obesity, paralysis, peripheral vascular disorders, psychoses, renal failure, solid tumor without metastasis, peptic ulcer disease excluding bleeding, valvular disease and weight loss.