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Prevalence of Alcohol Use Characterized by Phosphatidylethanol in Patients With Respiratory Failure Before and During the COVID-19 Pandemic

Ellen L. Burnham, MD,
Division of Pulmonary Sciences and Critical Care Medicine, Department of Medicine, University of Colorado, Anschutz Medical Campus, Aurora, CO.

Raymond Pomponio, BS,
Department of Medicine, Biostatistics and Informatics, Department of Medicine, University of Colorado, Anschutz Medical Campus, Aurora CO.

Grace Perry, BS,
Division of Pulmonary Sciences and Critical Care Medicine, Department of Medicine, University of Colorado, Anschutz Medical Campus, Aurora, CO.

Patrick J. Offner, BS,
Division of Pulmonary Sciences and Critical Care Medicine, Department of Medicine, University of Colorado, Anschutz Medical Campus, Aurora, CO.

Ryen Ormesher, MD,
Colorado School of Public Health, and Internal Medicine, Department of Medicine, University of Colorado, Anschutz Medical Campus, Aurora CO.

Ryan A. Peterson, PhD,
Department of Medicine, Biostatistics and Informatics, Department of Medicine, University of Colorado, Anschutz Medical Campus, Aurora CO.

Sarah E. Jolley, MD
Division of Pulmonary Sciences and Critical Care Medicine, Department of Medicine, University of Colorado, Anschutz Medical Campus, Aurora, CO.

Abstract

CORRESPONDENCE TO: Ellen L. Burnham, MD; Ellen.Burnham@cuanschutz.edu.

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BACKGROUND: Alcohol misuse is overlooked frequently in hospitalized patients, but is common among patients with pneumonia and acute hypoxic respiratory failure. Investigations in hospitalized patients rely heavily on self-report surveys or chart abstraction, which lack sensitivity. Therefore, our understanding of the prevalence of alcohol misuse before and during the COVID-19 pandemic is limited.

RESEARCH QUESTION: In critically ill patients with respiratory failure, did the proportion of patients with alcohol misuse, defined by the direct biomarker phosphatidylethanol, vary over a period including the COVID-19 pandemic?

STUDY DESIGN AND METHODS: Patients with acute hypoxic respiratory failure receiving mechanical ventilation were enrolled prospectively from 2015 through 2019 (before the pandemic) and from 2020 through 2022 (during the pandemic). Alcohol use data, including Alcohol Use Disorders Identification Test (AUDIT)-C scores, were collected from electronic health records, and phosphatidylethanol presence was assessed at ICU admission. The relationship between clinical variables and phosphatidylethanol values was examined using multivariable ordinal regression. Dichotomized phosphatidylethanol values (≥ 25 ng/mL) defining alcohol misuse were compared with AUDIT-C scores signifying misuse before and during the pandemic, and correlations between log-transformed phosphatidylethanol levels and AUDIT-C scores were evaluated and compared by era. Multiple imputation by chained equations was used to handle missing phosphatidylethanol data.

RESULTS: Compared with patients enrolled before the pandemic (n = 144), patients in the pandemic cohort (n = 92) included a substantially higher proportion with phosphatidylethanol-defined alcohol misuse (38% vs 90%; $P < .001$). In adjusted models, absence of diabetes, positive results for COVID-19, and enrollment during the pandemic each were associated with higher phosphatidylethanol values. The correlation between health care worker-recorded AUDIT-C score and phosphatidylethanol level was significantly lower during the pandemic.

INTERPRETATION: The higher prevalence of phosphatidylethanol-defined alcohol misuse during the pandemic suggests that alcohol consumption increased during this period, identifying alcohol misuse as a potential risk factor for severe COVID-19-associated respiratory failure. Results also suggest that AUDIT-C score may be less useful in characterizing alcohol consumption during high clinical capacity.

Keywords

ARDS; ICU; substance misuse; pneumonia

Individuals who consume alcohol exceeding recommended guidelines are considered to have alcohol misuse, or unhealthy alcohol consumption, placing them at risk of adverse health and social consequences.[1-3] Alcohol misuse is found in up to 20% of the general hospitalized patient population[4,5] and has particular financial implications in the ICU setting,[6-8] in part because of the need for interventions such as invasive mechanical ventilation.[9] Hospitalized patients with pneumonia and alcohol misuse display an increased severity of illness, including the need for prolonged ventilator support, the propensity for ARDS to develop, and a longer hospital length of stay.[9-15] Therefore, accurately identifying alcohol misuse in hospitalized patients would be useful prognostically.

The emergence of COVID-19 in association with respiratory failure and ARDS raised questions about the role of alcohol misuse, which reportedly increased during the COVID-19 pandemic.[16-18] Although alcohol misuse has been linked to an increased risk of COVID-19 infection,[19,20] its impact on COVID-19 outcomes is uncertain.[21-25] Notably, methods used to classify alcohol use in these investigations relied on patient self-report or medical record abstraction that might have influenced the findings.

When patients are admitted to the hospital for reasons unrelated to alcohol use, obtaining consumption information can be deprioritized,[26] particularly when an urgent need to address end-organ dysfunction exists. Although the Alcohol Use Disorders Identification Test (AUDIT)-C is used commonly in the ICU to identify alcohol misuse,[8,27,28] AUDIT-C surveys cannot be performed in patients lacking capacity. During the COVID-19 pandemic, implementation of crisis standards of care impacted both collection and recording of data deemed less essential,[29] such as alcohol use. Moreover, options for AUDIT-C score collection from patients' proxies were limited, given visitation restrictions. As such, understanding of alcohol use habits among critically ill patients during the COVID-19 pandemic remains obscure.

Measuring alcohol-specific biomarkers can help to clarify alcohol use habits. One biomarker, phosphatidylethanol, is formed on the surface of RBCs during the reaction of ethyl alcohol with phosphatidylcholine through the activity of phospholipase D. Phosphatidylethanol is measured from whole blood or dried blood spots using liquid chromatography followed by tandem mass spectroscopy.[30] Phosphatidylethanol can be detected for 3 to 4 weeks after consistent, heavy alcohol ingestion, having a half-life of 4 to 6 days.[31,32] A threshold of 25 ng/mL has been validated in critically ill patients to identify alcohol misuse,[2] encompassing habits from risky drinking to frank alcohol use disorder.[3] Guidelines for measuring phosphatidylethanol level to classify light or no alcohol consumption, significant consumption, or heavy consumption also exist.[33] Phosphatidylethanol values correlate with AUDIT-C score, with a strength of association dependent on the study population.[2,28,34] Given the relatively sparse characterization of alcohol use habits among hospitalized patients during the pandemic, we used data from a single-center cohort study to establish the proportion of critically ill patients with alcohol misuse between 2015 and 2022. Phosphatidylethanol measurements were used to characterize alcohol use in parallel with AUDIT-C scores and clinical data in the electronic medical record (EMR). We hypothesized that the proportion of patients with alcohol misuse would be elevated during the COVID-19 pandemic. We also sought to compare the performance characteristics of AUDIT-C with those of phosphatidylethanol in identifying alcohol misuse before and during the COVID-19 pandemic and to examine the relationship between certain demographic (eg, sex) and clinical (eg, BMI) features with phosphatidylethanol in the cohort.

Study Design and Methods

Data used for this investigation originated from an ongoing observational cohort study at the University of Colorado Hospital, an academic teaching hospital, including patients enrolled between January 2015 and January 2022 (Colorado Multiple Institutional Review Board

Identifier: 14-0630). Its main hypothesis was to determine the prevalence of alcohol misuse using validated methods and second, to determine the relationship between alcohol use on provision of clinical care (eg, administration of sedative agents) and inpatient outcomes (eg, days on mechanical ventilation). Patients requiring invasive mechanical ventilation for a primary respiratory illness were enrolled prospectively. Patients with the following characteristics were excluded: age younger than 18 years or older than 90 years, mechanical ventilation for a nonpulmonary indication, mechanical ventilation initiated > 48 h prior to screening, pregnancy, chronic immunosuppression (eg, positive HIV findings, prednisone equivalent use > 20 mg/d, immunosuppressive condition), current tracheostomy, history of chronic lung disease requiring ≥ 2 liters per minute oxygen, expected survival < 6 months, non-English or non-Spanish speaking, or decision to forego aggressive care. Enrollment occurred under waived consent with health care proxy assent. Attempts to reconsent enrolled patients for continued participation occurred when capacity was regained.

During the study period, nurse to patient ratios generally were 1:2, although ratios of up to 1:4 existed during 2020 and 2021 to accommodate patient volumes. Respiratory therapists implemented a protocolized low tidal volume ventilation strategy[35] with awakening and breathing trials.[36] Multidisciplinary rounds were conducted daily.

Clinical data were abstracted from the EMR by trained research coordinators. Patient alcohol use was determined using the best available clinical data. As routine practice in our hospital, AUDIT-C surveys typically are performed by bedside registered nurses at admission and are recorded in a designated EMR field. AUDIT-C score or other documentation pertaining to alcohol use (eg, alcohol-related complications) could have been captured by other health care providers. AUDIT-C data recorded by any health care provider was used in this investigation.

After protocol modifications in February 2016, RBC collection to measure phosphatidylethanol level was initiated. RBCs isolated from ethylenediamine tetraacetic acid-containing vacutainers were obtained immediately after patient enrollment except in patients with a hemoglobin of < 7 g/dL or who had received RBC transfusion before enrollment. Phosphatidylethanol was measured as described previously.[28]

Alcohol drinking habits were classified using clinical data, phosphatidylethanol data, or both. Current alcohol drinking was defined by any of the following: (1) measurable phosphatidylethanol or blood alcohol levels in clinical laboratory tests,[34] (2) endorsement of drinking by the patient or proxy, or (3) admission for an alcohol-related illness. Alcohol misuse was defined in two ways: (1) by AUDIT-C score of ≥ 3 (in female participants) or ≥ 4 (in male participants)[37] or (2) phosphatidylethanol level of ≥ 25 ng/mL.[2]

Based on expert guidelines, phosphatidylethanol measurements also were used to characterize relative quantity of alcohol consumption[33] to provide additional granularity regarding cohort drinking habits and likelihood for alcohol-related complications. Categories included: (1) light or no consumption (ie, abstinence to < 2 drinks/d, several days per week), when phosphatidylethanol measures < 20 ng/mL; (2) significant consumption (ie, 2-4 drinks/d, several days per week), when phosphatidylethanol measures 20 to 199

ng/mL; or (3) heavy consumption (ie, at least 4 drinks/d, several days per week), when phosphatidylethanol measures > 200 ng/mL.

Research aims included examining time trends in alcohol consumption in relationship to the COVID-19 pandemic and examining performance characteristics of AUDIT-C score and phosphatidylethanol level in identifying alcohol misuse. For this purpose, patients were stratified into cohorts by enrollment date: before the pandemic (2015-2019) and during the pandemic (2020-2022). An exploratory purpose of this investigation was to identify potential associations between alcohol misuse and in-hospital outcomes, controlling for important covariates.

Statistical Analyses

Cohort demographics and alcohol use metrics were summarized stratifying by pandemic era, with differences compared using Wilcoxon rank-sum tests and Fisher exact tests as appropriate. Because phosphatidylethanol measurements were empirically right-skewed, they were log-transformed when visualizing relationships between continuous phosphatidylethanol levels and other variables. The relationship between phosphatidylethanol level (as an outcome) and covariates of interest were modeled using ordinal regression, which flexibly models nonnormally distributed outcomes and produces adjusted ORs (aORs) as measurements of association. These aORs denote the relative increase in the odds of seeing higher vs lower values of the outcome given a change in the covariate. Covariates for the full phosphatidylethanol model included age, sex, race, ethnicity (Hispanic vs non-Hispanic), Acute Physiology and Chronic Health Evaluation II score at admission, diabetes, cirrhosis, smoking status, and COVID-19 status (negative, positive, or before pandemic).

We investigated dichotomized phosphatidylethanol values (≥ 25 ng/mL) defining alcohol misuse, comparing the diagnostic operating characteristics of AUDIT-C scores signifying misuse before and during the pandemic. Similarly, correlations between log-transformed phosphatidylethanol levels and AUDIT-C scores were evaluated and compared by era.

In our exploratory investigation of alcohol misuse as a possible risk factor for clinical outcomes, ordinal regression was used to produce a set of unadjusted ORs and aORs for phosphatidylethanol level-defined alcohol misuse on each outcome. Adjusted models included COVID-19 status (negative, positive, or before pandemic) and the covariates mentioned previously.

When participants were missing phosphatidylethanol values, we used multiple imputation by chained equations, stochastically imputing values using the observed associations among variables. All results presented were pooled across five multiply imputed datasets using Rubin rules, except where indicated.[38] We also performed a complete-case sensitivity analysis. Analysis was performed in R software version 4.2.1 (R Foundation for Statistical Computing),[39] and scripts to reproduce all results are available.

Results

A total of 233 participants were enrolled (Table 1). Of those, 141 participants (61%) were in the prepandemic cohort and 92 participants (40%) were in pandemic cohort. Cohorts were similar in mean age. The pandemic cohort included higher proportions of male patients (76% vs 57%), patients who identified as Hispanic (51% vs 23%), and patients who never used tobacco or had a history of smoking (80% vs 61%) compared with the prepandemic cohort. Patients in the pandemic cohort showed lower illness severity (defined by Acute Physiology and Chronic Health Evaluation II scores), but higher BMIs.

Alcohol Consumption In the Cohort Before and During the COVID-19 Pandemic

Among participants with available AUDIT-C scores (66% of patients before the pandemic and 87% of patients during the pandemic), values were similar across cohorts (Table 2). Among participants with phosphatidylethanol measurements (83% of prepandemic cohort and 99.6% of pandemic cohort), patients in the pandemic cohort demonstrated significantly higher phosphatidylethanol values compared with the prepandemic cohort. The relatively higher phosphatidylethanol levels during the pandemic were apparent when log-transformed phosphatidylethanol measurements were plotted by enrollment year (Fig 1). However, the relationship between AUDIT-C scores and year of enrollment was less obvious (e-Fig 1).

The proportion of patients defined as having current alcohol use was significantly higher in the pandemic cohort compared with the prepandemic cohort ($P < .001$). Alcohol misuse, defined by AUDIT-C score, was slightly less prevalent in the pandemic cohort; however, alcohol misuse defined by phosphatidylethanol level of ≥ 25 ng/dL existed in 38% of prepandemic cohort and 90% of the pandemic cohort ($P < .001$). Using phosphatidylethanol level to understand relative alcohol consumption, the proportion of patients with significant alcohol consumption in the pandemic cohort was twice as high, whereas the proportion of patients with heavy alcohol consumption was 2.5 times as high, compared with patients in the prepandemic cohort (Table 2). In the entire study population, male patients were represented more frequently in the heavy alcohol consumption group ($P = .02$) (Fig 2). We did not identify differences in phosphatidylethanol values by age, race, Hispanic ethnicity, or BMI.

Treating phosphatidylethanol level as an outcome, the odds for increased phosphatidylethanol values were greater among patients without diabetes (aOR, 2.9;95% CI, 1.5-5.6) or who showed positive COVID-19 findings compared with those with negative COVID-19 findings (aOR, 2.73; 95% CI, 1.1-6.9). The odds were lower in patients who were enrolled in the period before the pandemic (aOR, 0.42; 95% CI, 0.19-0.91) (e-Table 1). We found no evidence for other covariates to be associated conditionally with phosphatidylethanol values.

Operating Characteristics of AUDIT-C Score vs Phosphatidylethanol Value Before and During the Pandemic

Using data from the entire cohort, log-transformed phosphatidylethanol measurements were correlated with AUDIT-C scores (Fig 3). In examining the relationships stratified by the

phase of the pandemic, the correlation between log-transformed phosphatidylethanol values and AUDIT-C score was notably larger in patients enrolled before the pandemic (ρ = 0.58) compared with the pandemic cohort (ρ = 0.28). Slopes depicting these relationships were significantly different between assessments (P = .0011). These relationships were consistent with analyses conducted using either imputed or nonimputed data.

A lower proportion of patients had recorded AUDIT-C scores of 0 in the prepandemic cohort compared with the pandemic cohort (33% vs 60%). Interestingly, among these patients with an AUDIT-C score of 0, median phosphatidylethanol level on enrollment was 0 ng/mL (interquartile range, 0-0 ng/mL) in the prepandemic cohort vs 186 ng/mL (interquartile range, 53-340 ng/mL) in the pandemic cohort (P < .0001). For the entire cohort, patients with an AUDIT-C score of 0 showed a median phosphatidylethanol level of 72.0 ng/mL (interquartile range, 0-255 ng/mL).

The diagnostic characteristics for AUDIT-C score-classified alcohol misuse in identifying phosphatidylethanol level-defined alcohol misuse (as the gold standard) are presented by era in Table 3. During the pandemic, the specificity of AUDIT-C score increased, as did its positive predictive value, driven in part by greater prevalence of high phosphatidylethanol levels during the pandemic. In contrast, the sensitivity of AUDIT-C score declined during the pandemic, as did its negative predicted value.

Clinical Outcomes in the Cohort

Compared with patients in the prepandemic cohort, patients in the pandemic cohort underwent longer durations receiving mechanical ventilation in the ICU and in the hospital (Table 1). However, a greater proportion of patients in the pandemic cohort were discharged to home vs elsewhere. The in-hospital mortality rate did not differ significantly between the cohorts.

We did not identify associations between alcohol misuse (using the phosphatidylethanol value definition) and in-hospital outcomes in our models (Table 4). In separate sensitivity analyses, models were constructed substituting phosphatidylethanol values defining strata of alcohol consumption[33] (e-Table 2) or using AUDIT-C scores to define alcohol misuse (e-Table 3), adjusting for the same demographic characteristics. Results did not vary substantially from the original models. Full models presenting the relationship between alcohol consumption and days on mechanical ventilation, total number of ICU days, in-hospital mortality, and discharge home. adjusted for clinical covariates, are presented in the e-Tables 4-7.

Discussion

This study was designed to provide a more comprehensive picture of alcohol use among critically ill patients with respiratory failure in the context of the COVID-19 pandemic. It is the first study to our knowledge to use phosphatidylethanol measurements in parallel with survey and EMR data to define alcohol consumption in critically ill patients with COVID-19. Our study highlights the limitations of relying on patient or proxy report to identify alcohol use, particularly in high-volume, high-acuity clinical settings. Our findings

provide objective evidence for the magnitude of alcohol consumption during the pandemic and support a role for phosphatidylethanol to establish individual-level alcohol use in hospitalized and critically ill patients.

Although AUDIT-C scores did not vary based on enrollment period, phosphatidylethanol measurements in patients enrolled during the pandemic were significantly higher, translating to greater proportions of both those currently drinking alcohol and patients with alcohol misuse. Moreover, although AUDIT-C scores correlated with phosphatidylethanol measurements in the cohort, among individual patients with an AUDIT-C score of 0, concomitant phosphatidylethanol measurements categorized more than one-half of them with alcohol misuse. Notably, in our institution, the sensitivity of AUDIT-C score for alcohol misuse was approximately 46% before the pandemic and dropped to < 20% during the pandemic. Clinician time and resources are required to perform the AUDIT-C, and as such, it may be deferred or performed haphazardly in busy clinical settings, which may explain AUDIT-C scores of 0, or missing data, in our cohort. It is also likely that patients lacking capacity did not participate reliably in AUDIT-C assessment. As such, phosphatidylethanol measurements could be particularly useful in detecting and characterizing alcohol use habits where the prevalence of alcohol misuse disorder is high and would alleviate potential bias found in self-report or misclassification by clinicians.

The higher phosphatidylethanol levels observed in patients in the pandemic cohort adds to a growing body of research suggesting negative impacts of the pandemic on alcohol use,[40] as evidenced by studies demonstrating a positive relationship between alcohol sales and consumption,[16] the increase of alcohol-related deaths in the first year of the pandemic,[41] and evidence of increasing hazardous alcohol use.[42,43] However, heterogeneity in alcohol consumption during the first year of the pandemic also has been reported, including variable consumption outside of the United States and in relationship to certain sociodemographic factors.[44] Nevertheless, these reports are limited to inferences relying on patient-reported data or alcohol use disorder documented in the EMR.

We found no evidence that age, BMI, race, Hispanic ethnicity, Acute Physiology and Chronic Health Evaluation II score, cirrhosis, or smoking status were associated conditionally with phosphatidylethanol level, although associations with diabetes mellitus and positive COVID-19 findings were observed. Certain biologic factors have been reported to affect phosphatidylethanol sensitivity, including male sex, BMI, and cirrhosis,[45] which are important to consider for future research and clinical practice. Additionally, unlike the AUDIT-C, phosphatidylethanol measurement does not provide information on the pattern of alcohol use and can be elevated to a similar degree after a single episode of binge drinking or chronic ingestion of a lesser alcohol volume. Additionally, technology to measure phosphatidylethanol level at the point of care in clinical settings where alcohol misuse is highly prevalent would be ideal, but is not available currently.

Prior investigations in critically ill patients have reported associations between alcohol misuse and increased requirements for mechanical ventilation,[9,13] as well as increased risk of death[13,46] or persistent hospitalization at 90 days.[46] In patients specifically with COVID-19 pneumonia, we and other investigators have reported associations between

alcohol misuse and inpatient outcomes that include increased requirements for inpatient hospitalization,[21,23,24] development of delirium,[21] and in-hospital mortality.[23,24] In trying to assess the impact of alcohol misuse on outcomes in the current study, we were limited by the high proportion of patients with alcohol misuse in the cohort that affected our power to test for differences. Additionally, although beyond the scope of the current work, future investigations should focus on the relationship between alcohol misuse and development of ICU delirium and how this may be moderated by type(s) and dose(s) of medications used for sedation in the ICU. Because alcohol misuse can contribute independently to delirium, it is possible that patients with alcohol misuse received differential treatment with sedatives with the intent of promoting ventilator synchrony, but without recognition of alcohol's role in the clinical picture. Additionally, the role of alcohol misuse on the development of post-ICU care syndrome warrants additional consideration given the high prevalence of cognitive and mental health symptoms reported in patients with post-ICU care syndrome that could also be attributable to alcohol misuse.[47]

This study is not without limitations. Its single-center design and relatively small size make our findings less generalizable. Despite this, the cohort included patients enrolled before the COVID-19 pandemic and throughout a full 2 years of the pandemic, providing an opportunity to perform a natural experiment to examine alcohol consumption. Further, the cohort featured relatively robust ethnic and racial diversity. An additional limitation was missingness of phosphatidylethanol values and AUDIT-C scores for a subset of patients. These reasons for missingness primarily were operational, unrelated to patient-level confounders. Early in the study, some patients did not undergo RBC collection by protocol and could not have phosphatidylethanol measured. As previously mentioned, the AUDIT-C score might not have been collected by clinicians because of workload demands or in patients lacking capacity. Therefore, we do not believe them to be missing not-at-random. Further, because we are performing multiple imputation, we did not assume they are missing completely at random (as with a complete-case analysis), but that the missingness is random conditional on the observed data. We conducted a complete-case analysis, and the results were not altered. Moving forward, studies in larger, more representative patient cohorts would help to clarify further both the prevalence of alcohol use and misuse and their impact in critical illnesses with more precision.

Interpretation

Our study has two major findings. First, it demonstrated that a higher proportion of patients hospitalized for respiratory failure exhibited objective evidence of alcohol misuse during years of the COVID-19 pandemic relative to years immediately prior. Second, it underscored the usefulness of corroborative biomarker assessment for alcohol use in patients where self-reported or proxy-reported measurements are impossible or impractical during times of ICU stress. The high proportion of patients with alcohol misuse during the COVID-19 pandemic (particularly during 2020) parallels literature and media reports of increased alcohol consumption. Further research is necessary to understand mechanisms whereby alcohol may alter development of in-hospital complications such as delirium or may modulate recovery after critical illness.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATIONS:

aOR	adjusted OR
AUDIT-C	Alcohol Use Disorders Identification Test-C
EMR	electronic medical record

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Take-home Points

Study Question:

In a cohort of critically ill patients with respiratory failure, did the proportion of patients with alcohol misuse, defined by the level of the direct biomarker phosphatidylethanol, vary over a period including the COVID-19 pandemic?

Results:

Compared with patients enrolled before the pandemic between 2015 and 2019, patients enrolled between 2020 and 2022 included a substantially higher proportion with phosphatidylethanol-defined alcohol misuse (38% vs 90%; $P < .001$).

Interpretation:

The higher prevalence of phosphatidylethanol-defined alcohol misuse during the pandemic suggests that alcohol consumption increased during this period, identifying alcohol misuse as a potential risk factor for severe COVID-19-associated respiratory failure.

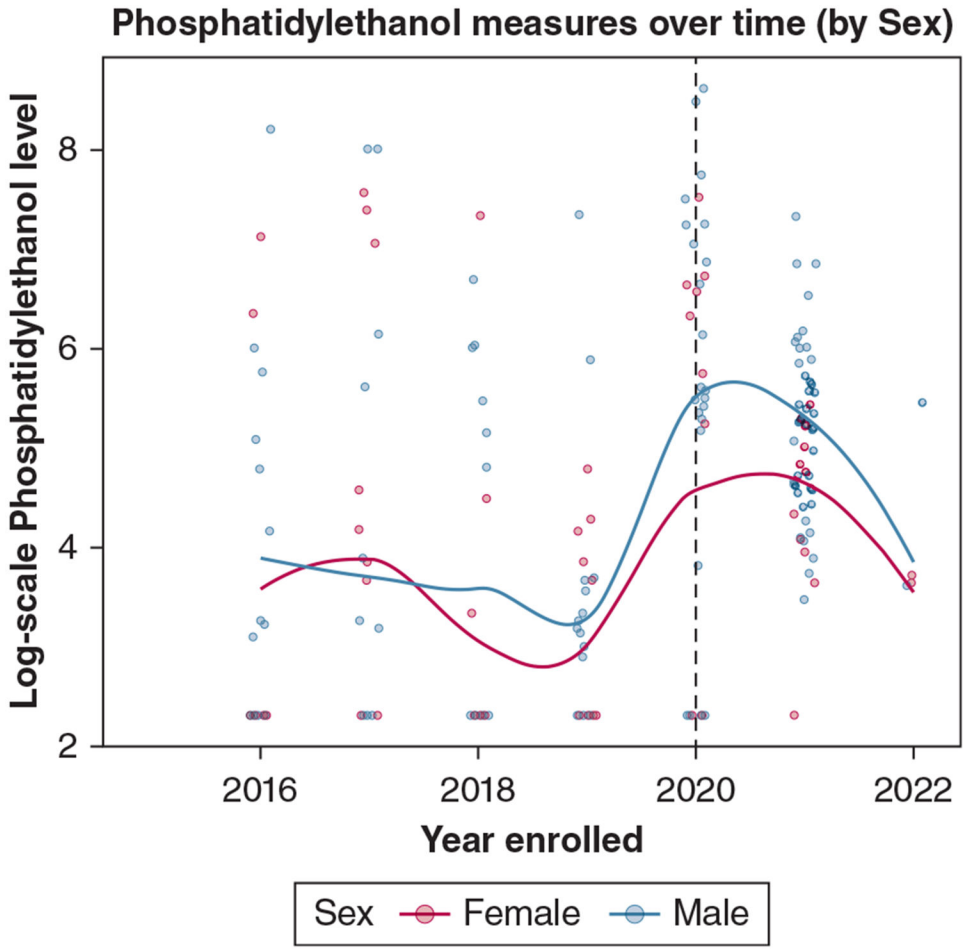

Figure 1 –.

Graph showing data from 192 total critically ill patients with phosphatidylethanol values (log transformed), stratified by sex, over time. Dashed vertical line represents approximate start of the pandemic.

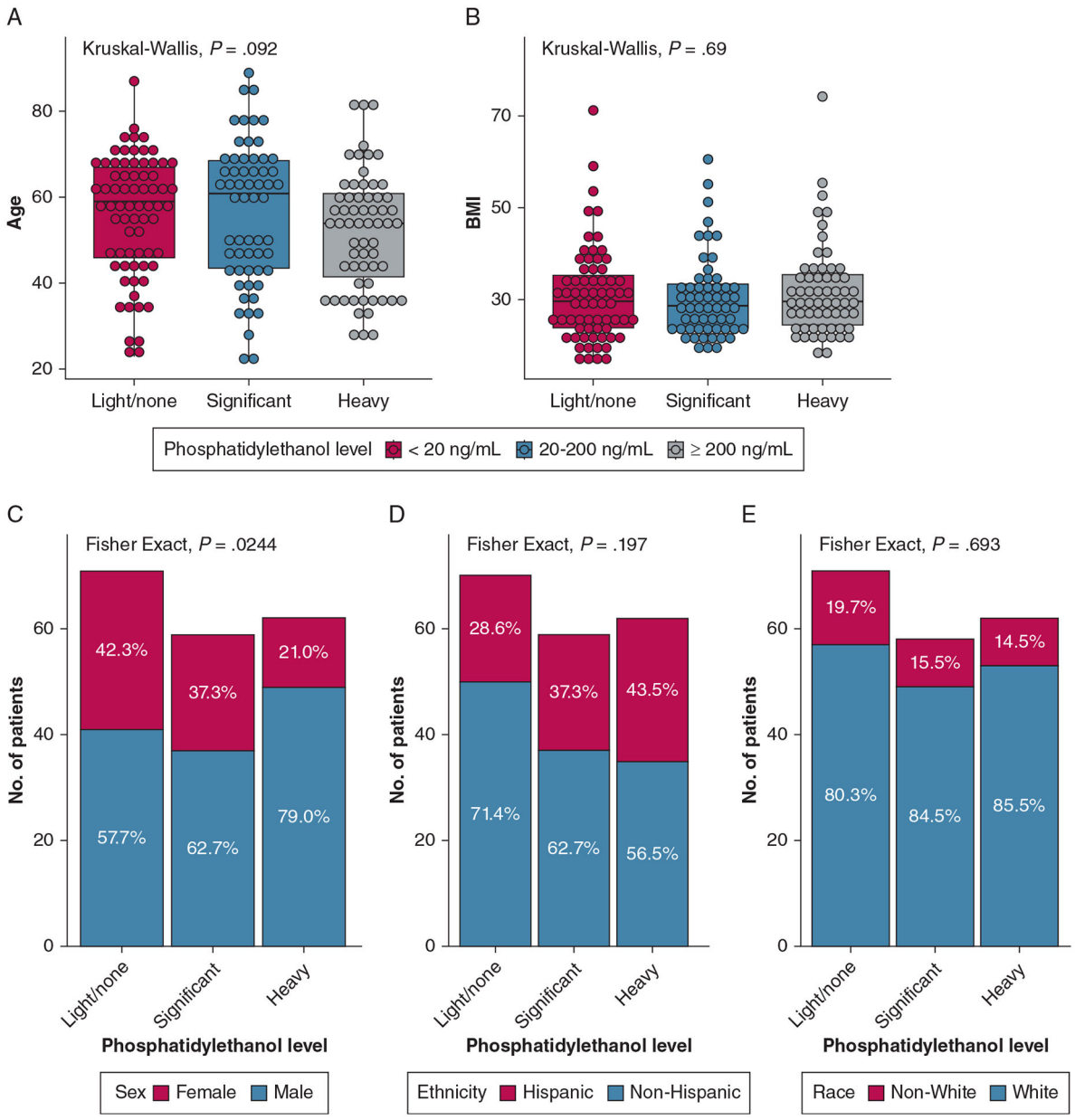

Figure 2 –.

Graphs showing the relationship between patient phosphatidylethanol values and demographic covariates of interest. Cohort (n = 177) stratified by phosphatidylethanol values indicating alcohol consumption habits (light or none, significant, or heavy). A-E, Phosphatidylethanol levels did not vary significantly by age (A), BMI (B), or race (E); however, the proportion of male patients in the heavy consumption subgroup was significantly higher (C), and the proportion of Hispanic patients was greater with increasing strata of phosphatidylethanol (D). Inferences are using complete-case analysis.

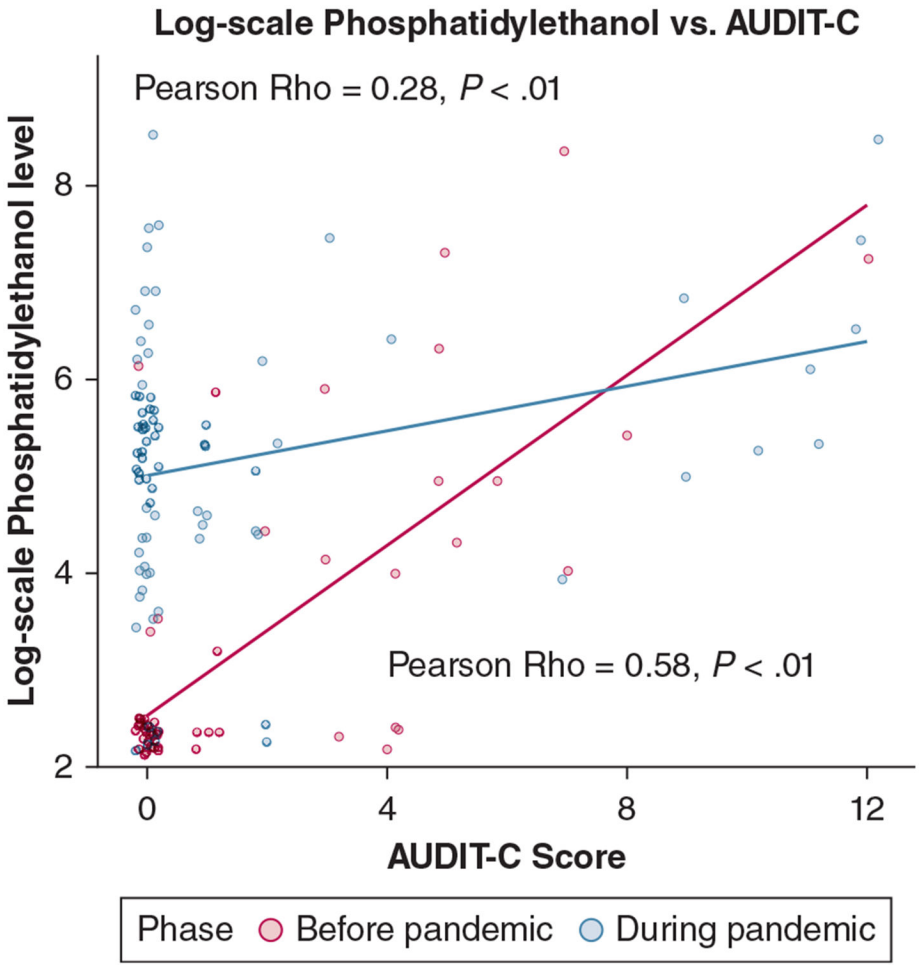

Figure 3 –.

Graph showing the relationship between patient phosphatidylethanol values and clinically obtained AUDIT-C score. Data from 133 patients with AUDIT-C scores and phosphatidylethanol values (multiple imputations used for inferential results). Both correlations were significantly different from zero. In the prepandemic cohort, correlation between AUDIT-C score and phosphatidylethanol value was higher (ρ = 0.58, red line) compared with the pandemic cohort (ρ = 0.28, blue line), with these two correlations differing significantly from each other (P = .0011). AUDIT-C = Alcohol Use Disorders Identification Test-C.

TABLE 1]

Study Demographics and In-Patient Outcomes, Stratified by Era Before or During the COVID-19 Pandemic

Clinical Characteristic	Before Pandemic, 2015-2019 (n = 141)	During Pandemic, 2020-2022 (n = 92)	P Value
Age, y	54.5 ± 13.9	55.2 ± 15.0	0.8
Male sex	80 (57)	70 (76)	.003
Hispanic ethnicity	32 (23)	47 (51)	< .001
Race (self-reported)			
Black	20 (14)	8 (8.7)	…
American Indian	1 (0.7)	1 (1.1)	…
Asian	3 (2.1)	1 (1.1)	…
Pacific Islander	2 (1.4)	2 (2.2)	…
White	112 (79)	79 (86)	…
> 1 Race	2 (1.4)	0 (0)	…
Unknown/declined to answer	1 (0.7)	1 (1.1)	…
Non-White race[a]	28 (20)	12 (13)	.2
No or past history of smoking	83 (61)	74 (80)	.001
APACHE II score at admission	20 ± 7	18 ± 7	.022
History of diabetes	36 (26)	20 (22)	.5
History of cirrhosis	19 (13)	6 (7)	.13
BMI, kg/m^2	29.5 ± 9.6	32.6 ± 10.2	.012
Outcomes			
Mechanical ventilation duration, d	5.0 (2.8-10)	8.0 (4.0-15)	< .001
ICU length of stay, d	9.0 (5.0-13)	11 (7.0-19)	.007
Hospital length of stay, d	14 (9.0-24)	17 (11-26)	.044
Discharged to home	49 (35)	47 (51)	.015
In-hospital mortality	40 (28)	22 (24)	.5

Data are presented as No. (%), mean ± SD, or median (interquartile range), unless otherwise indicated. Comparisons are based on complete-case analysis.

APACHE = Acute Physiology and Chronic Health Evaluation. Statistical tests not performed for individual racial categories due to small sample sizes; numbers provided for additional description only.

[a]Non-White race includes all “self-reported race” categories except White and unknown/refused to answer.

TABLE 2]

Alcohol Use in the Cohort

Patient Alcohol Use Metrics and Characteristics	Before Pandemic (n = 141)	During Pandemic (n = 92)	*P* Value
AUDIT-C score[a]	0 (0-3)	0 (0-1)	.2
Phosphatidylethanol level, ng/mL[b]	0 (0-79)	186 (69-398)	< .001
Alcohol misuse			
AUDIT-C score definition	20 of 87 (26)	11 of 81 (14)	.072
Phosphatidylethanol value definition	38 of 101 (38)	82 of 91 (90)	< .001
Composite definition indicating current alcohol consumption[c]	81 (60)	85 (93)	< .001
Phosphatidylethanol level definition indicating current drinking quantity			< .001
Light or no (< 20 ng/mL)	63 (62)	8 (9)	
Significant (20-199 ng/mL)	19 (19)	40 (44)	
Heavy (≥ 200 ng/mL)	19 (19)	43 (47)	

Data are presented as No. (%) or median (interquartile range), unless otherwise indicated.

AUDIT-C = Alcohol Use Disorders Identification Test-C.

[a]Data missing from 54 patients before the pandemic and 11 patients during the pandemic.

[b]Data missing from 40 patients before the pandemic and one patient during the pandemic.

[c]Could not be determined in eight patients. Comparisons based on complete-case analysis.

TABLE 3]

Operating Characteristics of AUDIT-C vs Phosphatidylethanol Before and During the Pandemic

Metric	Before Pandemic	During Pandemic
Sensitivity	0.458 (0.32-0.59)	0.172 (0.08-0.26)
Specificity	0.910 (0.85-0.97)	0.982 (0.89-1.07)
Positive predictive value	0.803 (0.71-0.89)	0.987 (0.92-1.05)
Negative predictive value	0.679 (0.6-0.76)	0.127 (0.06-0.2)

Data are presented as decimals (95% CI). AUDIT-C = Alcohol Use Disorders Identification Test-C.

TABLE 4]

Effects of Alcohol Misuse Disorder, Defined by Phosphatidylethanol Level, on Selected ICU and Hospital Outcomes in Unadjusted Analyses and After Adjustment for Covariates

	Unadjusted			Adjusted		
Outcome	**OR[a]**	**95% CI**	***P* Value**	**aOR**	**95% CI**	***P* Value**
Mechanical ventilation days	1.26	0.73-2.17	.39	0.81	0.39-1.69	.56
ICU days	1.19	0.72-1.97	.49	1.04	0.56-1.93	.90
Hospital days	1.07	0.66-1.76	.78	0.87	0.47-1.60	.65
Mortality	0.95	0.49-1.86	.88	1.63	0.67-3.98	.28
Discharge to home	1.79	0.99-3.22	.054	1.14	0.52-2.51	.74

Data are presented as No. The estimates are the effects of alcohol misuse defined by phosphatidylethanol level (≥ 25 ng/dL vs < 25 ng/dL) on each inpatient outcome. Adjusted effects were estimated from models with covariates including age, sex, race, ethnicity, Acute Physiology and Chronic Health Evaluation II score, diabetes, cirrhosis, current smoking, and COVID-19 status. Phosphatidylethanol results were pooled from five multiply imputed datasets to categorize patients as having alcohol misuse disorder vs not having alcohol misuse disorder at the 25-ng/mL threshold.

[a]Having higher values of the outcome (eg, the OR of remaining on a ventilator for a greater number of days).