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Community-Acquired Pneumonia in the COVID-19 Era: Age-Stratified Features, Severity Score Performance, and Microbiological Determinants of Outcome in a Colombian Cohort

Lu Wang[†], **Tian Ruan*** [†]
Yunnan Medical and Health College, Kunming 650031, Yunnan, China
[†]These authors contributed equally to this work and are co-first authors.

Corresponding author: Tian Ruan, tianruan777@126.com

Abstract: *Background:* The COVID-19 pandemic reshaped the epidemiology and outcomes of community-acquired pneumonia (CAP), yet high-quality data from low- and middle-income countries (LMIC) in Latin America remain scarce. We characterized CAP in a Colombian inpatient cohort during the pandemic, comparing COVID-19 and non-COVID-19 CAP, evaluating age-stratified risk, benchmarking three severity scores, and quantifying the prognostic impact of microbial coinfection. *Methods:* This retrospective analysis used the NACef (Community-Acquired Pneumonia, Endotypes, and Phenotypes) dataset of 768 adults hospitalized with CAP at Clínica Universidad de La Sabana, Colombia (January 2020–July 2022). Outcomes included ICU admission, mechanical ventilation, and in-hospital death. Continuous and categorical variables were compared with Mann–Whitney U and χ^2/Fisher tests; the area under the receiver-operating-characteristic curve (AUC) benchmarked SOFA, CURB-65, and PSI; multivariable logistic regression identified independent mortality predictors. *Results:* Among 768 patients (mean age 59.2 ± 14.6 years; 62.8% male; 81.1% COVID-19-positive), 34.0% required ICU admission, 41.4% mechanical ventilation, and 23.6% died in hospital. COVID-19 CAP carried nearly double the mortality of non-COVID-19 CAP (26.0% vs 13.3%; relative risk 1.96, 95% CI 1.26–3.04) and far higher ventilation rates (45.9% vs 21.7%; $p < 0.001$), despite comparable admission severity scores. Mortality rose monotonically across age strata from 12.5% (< 50 years) to 33.9% (70–79 years), and each year of age independently increased death risk (adjusted OR 1.034/year). PSI was the strongest single discriminator of mortality (AUC 0.751) but all three scores performed similarly (DeLong $p > 0.05$); PSI excelled in younger patients (AUC 0.795) whereas SOFA was superior in those aged ≥ 65 (AUC 0.745). Microbial coinfection, present in 9.6% of patients, independently predicted death (adjusted OR 2.91, 95% CI 1.55–5.32). *Conclusions:* In this first systematic analysis of a Latin American CAP cohort spanning the pandemic, COVID-19, advancing age, and bacterial coinfection were robust, independent mortality drivers. No single severity score dominated; age- and context-tailored score selection is warranted. These findings provide locally relevant evidence for CAP management in LMIC settings.

Keywords: Community-acquired pneumonia; COVID-19; Severity scores; Coinfection; Latin America; LMIC

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1. Introduction

Community-acquired pneumonia (CAP) remains among the most common and lethal infectious diseases worldwide. In the

United States alone, CAP accounts for approximately 1.4 million emergency visits, 740,000 hospitalizations, and 41,000 deaths each year, and between 5% and 10% of hospitalized patients require intensive care [1]. The global burden is disproportionately borne by low- and middle-income countries (LMIC), where diagnostic infrastructure, antimicrobial stewardship, and critical-care capacity are often constrained, and where Streptococcus pneumoniae, respiratory viruses, and Gram-negative bacilli circulate with patterns and resistance profiles that differ markedly from those in high-income regions.

Such shifts underscore the need to re-examine CAP phenotypes, risk stratification, and microbiology specifically within the pandemic context, and in populations whose baseline epidemiology differs from those that generated existing evidence [2].

Three pillars of CAP management merit reappraisal in this setting. First, the clinical divergence between COVID-19 and traditional CAP is increasingly recognized—SARS-CoV-2 pneumonia features lymphopenia, hypercoagulability, and a predominantly viral etiology, contrasting with the polymicrobial and often bacterial profile of classic CAP [3]. How this divergence manifests in a Latin American population, where vaccination uptake, variant waves, and healthcare capacity followed their own timeline, is poorly described. Second, age is the strongest demographic risk factor for CAP death; incidence climbs steeply beyond 65 years, yet most prognostic models reduce age to a simple dichotomy, obscuring heterogeneity within the elderly and offering little granularity for middle-aged adults who constitute much of the working-age disease burden [1].

Latin America is notably underrepresented in this literature. The NACef (Community-Acquired Pneumonia, Endotypes, and Phenotypes) dataset, the first Colombian clinical database on PhysioNet, offers a unique opportunity to address this gap [4]. It prospectively captured 83 clinical variables from 768 CAP inpatients between January 2020 and July 2022, a period in which 81.1% of patients had confirmed or suspected COVID-19, and in whom severity scores, microbiology, and granular outcomes were systematically recorded.

We therefore conducted a comprehensive secondary analysis of NACef to (i) contrast COVID-19 and non-COVID-19 CAP in a uniform care environment, (ii) define age-stratified clinical and prognostic profiles across five age bands, (iii) benchmark SOFA, CURB-65, and PSI for mortality and resource-use prediction, and (iv) quantify the prognostic weight of microbial coinfection. We hypothesized that COVID-19 status, advancing age, and coinfection would each independently drive adverse outcomes and that severity-score performance would be context-dependent rather than uniformly superior for any single score.

2. Methods

2.1. Study design and data source

This is a retrospective cohort analysis of the NACef dataset, comprising 768 adults (≥ 18 years) hospitalized with CAP at Clínica Universidad de La Sabana, a tertiary teaching hospital in Chía, Colombia, from January 2020 to July 2022. Patients met the ATS/IDSA CAP diagnostic criteria and were enrolled within 24 hours of admission. Data were collected prospectively on the REDCap platform across baseline, in-hospital follow-up, and post-discharge time points, then de-identified to HIPAA standards. The original study was approved by the institutional ethics committee (approval 021, 4 February 2020), and the dataset is publicly available on PhysioNet following credentialed access. Full dataset characteristics are described by Sanabria-Herrera et al. [4]. This secondary analysis follows the STROBE guidance for observational studies.

2.2. Variables and definitions

The primary outcome was in-hospital mortality, defined as a composite of ICU and general-ward death. Secondary outcomes were ICU admission and mechanical ventilation (any modality) during the hospital stay. Exposure variables comprised demographics (age, sex, body mass index [BMI]), comorbidities (COPD, smoking history), and the three severity scores recorded at admission: SOFA (0–24, capturing six organ systems), CURB-65 (0–5), and PSI. Microbiological variables included etiologic pathogen identification and coinfection, defined as documentation of a second

microorganism alongside the primary etiologic agent. COVID-19 status was defined by suspected/confirmed COVID-19. To capture comorbidity burden, the structured comorbidity field was parsed and counted per patient.

2.3. Statistical analysis

Continuous variables are presented as mean ± standard deviation or median (interquartile range [IQR]) and compared using the Mann–Whitney U test (two groups) or Kruskal–Wallis test (≥ 3 groups). Categorical variables are summarized as n (%) and compared with χ^2 or Fisher's exact tests as appropriate. Trends with age were assessed using Spearman rank correlation. Predictive performance of each severity score was quantified by the area under the receiver-operating-characteristic curve (AUC), computed via the rank-based Mann–Whitney statistic with Hanley–McNeil standard errors, and pairwise AUC comparisons used a DeLong-style z-test. Optimal cutoffs were derived by maximizing the Youden index. Multivariable logistic regression, with 1,000-iteration bootstrap estimation of 95% confidence intervals (CIs), identified independent mortality predictors; model covariates were selected on clinical grounds (age, COVID-19 status, SOFA, coinfection). Complete-case analysis was applied per outcome given low missingness (< 5% for most variables). Two-tailed $p < 0.05$ defined statistical significance. Analyses were performed in Python (pandas 2.2, NumPy 2.0, SciPy, scikit-learn).

3. Results

3.1. Cohort characteristics

The 768 patients had a mean age of 59.2 ± 14.6 years (range 19–90); 482 (62.8%) were male and mean BMI was 27.7 ± 5.8 kg/m^2. Six hundred and twenty-three patients (81.1%) were COVID-19-positive. During hospitalization, 261 (34.0%) were admitted to the ICU, 318 (41.4%) required mechanical ventilation, and 181 (23.6%) died (163 ICU deaths, 31 ward deaths). Admission severity was moderate on average: SOFA 3.2 ± 2.8, CURB-65 1.3 ± 1.1, and PSI 80.1 ± 37.7.

3.2. COVID-19 versus non-COVID-19 CAP

COVID-19 patients were younger (median 58 [IQR 48–68] vs 64 [52–76] years; $p = 0.001$), more often male (65.0% vs 53.1%; $p = 0.011$), and had higher BMI (median 27.8 vs 25.4 kg/m^2; $p < 0.001$). COPD was less frequent in the COVID-19 group (8.8% vs 17.5%; $p = 0.004$), while smoking prevalence was identical (about 18%). Crucially, admission severity scores did not differ (SOFA, CURB-65, and PSI all $p > 0.10$), yet outcomes diverged sharply: COVID-19 CAP required mechanical ventilation more than twice as often (45.9% vs 21.7%; $p < 0.001$) and carried nearly double the mortality (26.0% [162/623] vs 13.3% [19/143]; $p = 0.002$), corresponding to a relative risk of 1.96 (95% CI 1.26–3.04). An etiologic pathogen was identified in 89.4% of COVID-19 versus 30.8% of non-COVID-19 cases ($p < 0.001$), reflecting routine SARS-CoV-2 RT-PCR testing. These data indicate that, in a uniform care environment, COVID-19 CAP followed a more aggressive respiratory course than non-COVID-19 CAP despite presenting with equivalent baseline severity—a divergence that conventional scores, calibrated on bacterial disease, did not capture at admission.

3.3. Age-stratified analysis

Mortality rose monotonically across age bands: 12.5% (< 50 years), 23.5% (50–59), 26.6% (60–69), 33.9% (70–79), and 29.2% (≥ 80) (**Figure 1**). The slight decrease in the oldest group (≥ 80) coincided with reduced ventilation use (27.7%), suggesting limitations in aggressive support for the frailest patients. Age correlated significantly with death (Spearman r = 0.190, $p < 0.001$) and with each severity score, most strongly with PSI (r = 0.581) and CURB-65 (r = 0.498), both of which embed age as a component. The proportion of patients with ≥ 3 comorbidities increased from 4.0% (<50 years) to 40.0% (≥ 80 years), a tenfold gradient, and comorbidity burden differed significantly across strata (Kruskal–Wallis $p < 0.001$ for SOFA, CURB-65, and PSI).

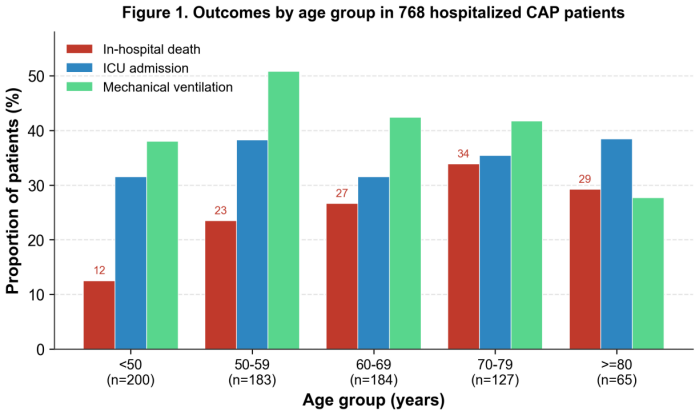

Figure 1. In-hospital death, ICU admission, and mechanical ventilation by age group among 768 hospitalized CAP patients. Mortality rises monotonically with age, peaking in the 70–79 group, while ventilation declines in the oldest patients. COVID-19 = coronavirus disease 2019; ICU = intensive care unit.

Unadjusted logistic regression estimated a 3.3% increase in mortality odds per year of age (OR 1.033/year, 95% CI 1.021–1.045). In a multivariable model adjusted for COVID-19 status and SOFA (n = 727), age remained an independent predictor (OR 1.034/year, 95% CI 1.021–1.051), alongside COVID-19 positivity (OR 3.004, 95% CI 1.774–6.112) and SOFA (OR 1.316/point, 95% CI 1.216–1.478). The persistence of an independent age effect after adjustment for a composite organ-dysfunction score indicates that age captures vulnerability, frailty, immune senescence, cumulative comorbidity, beyond what is measurable at a single severity-score timepoint.

3.4. Severity score performance

For in-hospital mortality, PSI achieved the highest AUC (0.751, 95% CI 0.706–0.795), followed by SOFA (0.740, 0.694–0.785) and CURB-65 (0.724, 0.679–0.770); pairwise DeLong comparisons were non-significant (all $p > 0.25$), indicating comparable discriminative ability (**Figure 2**). For ICU admission, performance was modest across all scores (AUC 0.60–0.64), reflecting that ICU triage incorporates factors beyond baseline severity; for mechanical ventilation, SOFA was nominally best (AUC 0.708 vs 0.680 vs 0.673). Youden-derived optimal cutoffs for mortality were SOFA ≥ 4 (sensitivity 0.59, specificity 0.79), CURB-65 ≥ 2 (0.63, 0.68), and PSI ≥ 74 (0.85, 0.57).

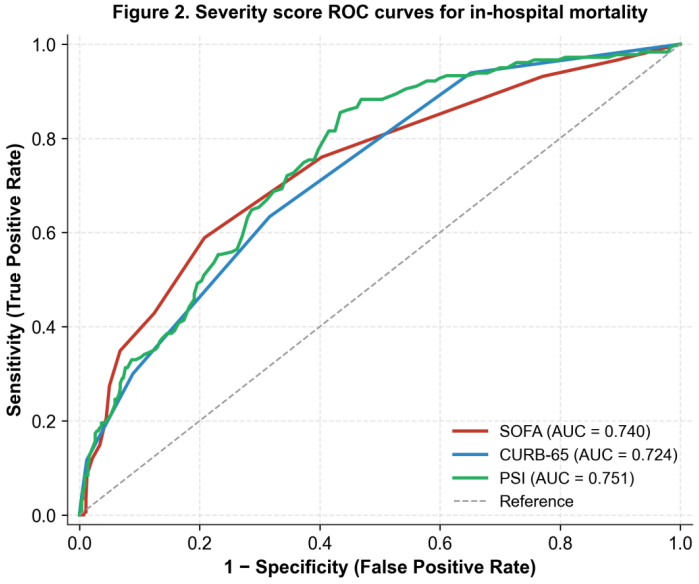

Figure 2. Receiver-operating-characteristic curves for SOFA, CURB-65, and Pneumonia Severity Index (PSI) in predicting in-hospital mortality among 768 hospitalized CAP patients. Areas under the curve (AUC) were 0.740 for SOFA, 0.724 for CURB-65, and 0.751 for PSI; pairwise comparisons were non-significant. AUC = area under the curve; SOFA = Sequential Organ Failure Assessment.

Subgroup analyses revealed clinically important context-dependence. Among COVID-19 patients, PSI retained the lead (AUC 0.771) over SOFA (0.740) and CURB-65 (0.731). Stratified by age, PSI performed best in patients < 65 years (AUC 0.795) but weakened in those ≥ 65 years (0.668), whereas SOFA remained stable and superior in the elderly (AUC 0.745 vs PSI 0.668). This inversion suggests that organ-dysfunction assessment (SOFA) is more informative than the age-weighted PSI once advanced age is ubiquitous and no longer discriminates between individuals.

3.5. Microbiology and coinfection

An etiologic pathogen was identified in 603 patients (78.5%), with SARS-CoV-2 dominating (568/603, 93.9% of identified pathogens). Bacterial pathogens were uncommon*: Staphylococcus aureus* (1.5%), *Klebsiella pneumoniae* (1.2%), *Haemophilus influenzae* (0.8%), and *Pseudomonas aeruginosa* (0.7%); *Streptococcus pneumoniae* was identified in only a single case, a striking finding that likely reflects both the viral-predominant pandemic case mix and the limits of culture-based diagnostics in patients receiving pre-hospital antibiotics. Coinfection was documented in 74 patients (9.6%) and was strongly associated with adverse outcomes: coinfection patients had markedly higher mortality (47.3% [35/74] vs 21.1% [132/626]; $p < 0.001$), ICU admission (73.0% vs 28.3%; $p < 0.001$), and ventilation (85.1% vs 35.9%; $p < 0.001$), and longer antibiotic courses (median 8 vs 5 days; $p < 0.001$). In multivariable analysis adjusting for age, COVID-19, and SOFA, coinfection independently predicted death (OR 2.913, 95% CI 1.548–5.321), the largest effect size of any studied predictor. Empiric antibiotics were given to 451 patients (58.7%), with combination therapy in 263 (34.2%), indicating substantial empirical antimicrobial exposure in a cohort whose confirmed bacterial yield was only 4%.

4. Discussion

This analysis of 768 Colombian inpatients provides several locally relevant insights into CAP during the COVID-19 era. First, COVID-19 CAP was the dominant phenotype and was substantially more lethal than non-COVID-19 CAP (26.0% vs 13.3%), with a near-doubling of ventilation requirements, even though the two groups presented with indistinguishable admission severity scores. This discordance implies that conventional scores, designed for bacterial CAP, underestimate the trajectory of viral pneumonia and supports mandatory SARS-CoV-2 (and influenza) testing on admission, as recommended in current guidance [1]. Our mortality figures are consistent with the pandemic-era deterioration in CAP outcomes reported in Canada and sit within the 20–25% range described in the source dataset publication, lending external coherence to the findings [2, 4].

Second, age was a continuous, independent mortality driver. The five-band stratification exposed a near-tripling of death from the youngest to the 70–79 stratum and a tenfold rise in multimorbidity prevalence. Notably, mortality dipped slightly in the ≥ 80 group alongside reduced ventilation, a pattern compatible with practice variation or limitation of life-sustaining treatment in the frailest patients, an interpretive caveat rather than evidence of biological protection. The independent age effect surviving adjustment for SOFA reinforces that a single severity snapshot cannot fully encode the cumulative physiological reserve captured by age, and it argues for retaining explicit age-weighting in any locally calibrated model.

Third, the three severity scores were statistically indistinguishable overall, but their relative value was context-dependent: PSI led in younger and COVID-19 patients, whereas SOFA retained discrimination in the elderly. This extends a literature in which SOFA and PSI have variously been reported as superior and argues against a single universal score [5, 6]. A pragmatic recommendation for LMIC settings is to use PSI (or CURB-65, which requires no laboratory tests and is feasible in resource-limited front-line care) for initial triage, and to add SOFA when ICU admission is contemplated or when age attenuates PSI's incremental value. The modest AUCs for ICU admission (0.60–0.64) across all scores also indicate that site-level capacity and clinician judgment, unmeasured here, substantially govern triage decisions, a known source of between-center variation in CAP care.

4.1. Limitations

This was a single-center, observational analysis; causal inference is constrained, and unmeasured confounding (treatment timing across pandemic waves, circulating viral variants, vaccination status, corticosteroid use) may operate. The cohort is COVID-19-enriched (81.1%), limiting statistical power for non-COVID-19 subgroup inference; the smaller non-

COVID-19 group (n = 143) yields wider confidence intervals, and the higher AUCs observed there (e.g., SOFA 0.763) are correspondingly less precise[7].

5. Conclusion

In this first systematic analysis of a Latin American CAP cohort spanning the COVID-19 pandemic, COVID-19 positivity, advancing age, and microbial coinfection each independently drove in-hospital mortality. No single severity score was universally superior; PSI excelled in younger and COVID-19 patients while SOFA was preferable in the elderly. These findings support age- and context-tailored risk stratification, routine viral testing on admission, targeted rather than empirical antibiotic use informed by rapid diagnostics, and vigilant surveillance for coinfection in deteriorating patients, principles directly transferable to CAP care in LMIC settings. Future work should validate these score-performance patterns in multicenter Latin American cohorts and integrate biomarker and pathogen-level data into locally calibrated prediction models to support precision management of CAP.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Vaughn V, Dickson R, Horowitz J, et al., 2024, Community-Acquired Pneumonia. JAMA, 332(15): 1282.

[2] Lee T, Walley K, Boyd J, et al., 2023, Impact of the COVID-19 Pandemic on Non-COVID-19 Community-Acquired Pneumonia: A Retrospective Cohort Study. BMJ Open Respiratory Research, 10(1): e001810.

[3] Torres A, Cillóniz C, Niederman M, et al., 2021, Pneumonia. Nature Reviews Disease Primers, 7(1): 25.

[4] Sanabria-Herrera N, Garcia-Gallo E, Duque-Vallejo S, et al., 2025, The Community-Acquired Pneumonia Endotypes and Phenotypes Dataset. Scientific Data, 12(1): 1686.

[5] Iftikhar S, Waagsbø B, 2025, Assessment of Disease Severity in Hospitalized Community-Acquired Pneumonia by the Use of Validated Scoring Systems. BMC Pulmonary Medicine, 25(1): 100.

[6] Bradley J, Sbaih N, Chandler T, et al., 2022, Pneumonia Severity Index and CURB-65 Score Are Good Predictors of Mortality in Hospitalized Patients with SARS-CoV-2 Community-Acquired Pneumonia. Chest, 161(4): 927–936.

[7] Che Y, Noor N, Azman Y, 2023, Bacterial Coinfection and Antibiotic Resistance in Hospitalized COVID-19 Patients: A Systematic Review and Meta-Analysis. PeerJ, 11: e15265.