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Factors Associated with Mortality in Adults ≥65 Years with Bacteremia in a Tertiary Referral Care Hospital in Manizales/Colombia, 2020–2023

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Abstract

Background

Bacteremia in older adults represents a highly complex clinical condition with elevated mortality, driven by population aging, multimorbidity, immunosenescence, and atypical clinical presentations. Thirty-day mortality ranges from 30% to 50%, significantly higher than in younger populations.

Objective

Identify sociodemographic, clinical, and microbiological factors associated with in-hospital mortality in adults aged ≥ 65 years diagnosed with bacteremia in a tertiary care hospital in Manizales/Colombia between 2020 and 2023.

Methods

A retrospective observational analytical cohort study including 400 patients with bacteremia confirmed by blood cultures.

Results

The population was characterized by a high burden of comorbidities, predominance of males, low educational level, and some degree of functional dependence. Overall mortality was 45%, with no significant differences between age groups. The most frequently isolated microorganisms were Gram-negative bacilli, particularly *Escherichia coli* and *Klebsiella pneumoniae*. No statistically significant association was found between antimicrobial resistance patterns and mortality. In multivariate analysis, factors independently associated with higher mortality were immunosuppression, high Charlson Comorbidity Index, coexistence of COVID-19, and abdominal source of infection.

Conclusions

This cohort of adults aged ≥ 65 years with bacteremia showed high mortality consistent with international reports, primarily driven by individual clinical factors such as immunosuppression, abdominal source, and COVID-19 infection during hospitalization.

BACKGROUND

Bacteremia is a complex clinical syndrome(1) defined as the presence of microorganisms in the bloodstream confirmed by blood cultures (1, 2). Its reported incidence is approximately 2 cases per

1,000 emergency department visits (3, 4), with up to 40% occurring in adults aged ≥ 65 years (3, 5). Thirty-day mortality ranges between 30% and 50% (3, 6, 7), up to three times higher than in younger populations, largely due to aging, multimorbidity, immunosenescence, and atypical clinical presentation (3). The most common infection sources in older adults include urinary tract (45–55%), respiratory (10–25%), intra-abdominal (10%), and unknown origin (10%) (3, 8). The most frequently isolated pathogens are *Escherichia coli*, *Staphylococcus aureus*, and *Streptococcus pneumoniae* (4, 6).

Currently, there are limited studies evaluating bloodstream infections and mortality in adults aged ≥ 65 years (3, 9), particularly regarding the role of comorbidities, immunosenescence, and functional status (6, 10).

The aim of this study was to identify sociodemographic, clinical, and microbiological factors associated with in-hospital mortality in adults aged ≥ 65 years with bacteremia.

METHODS

Study design

Observational, analytical, retrospective cohort study.

Setting and participants

Patients aged ≥65 years diagnosed with bacteremia confirmed by blood culture according to international guidelines (IDSA and American Society for Microbiology) (11), treated at Departamental Hospital Santa Sofía, a tertiary care hospital in Manizales/Colombia with 129 beds, between 2020 and 2023. Patients were followed until death or hospital discharge.

Inclusion criteria:

Adults ≥65 years with a first episode of bacteremia confirmed by blood culture.

Exclusion criteria:

Patients with incomplete sociodemographic, clinical, or microbiological data.

Variables and measurements:

Clinical data were obtained from electronic medical records. Infection source was determined based on clinical documentation.

- Comorbidities: Charlson Comorbidity Index
- Functional status: Barthel Index (10,12) and it was classified according to international validations (6,7)
- Bacteremia classification: community-acquired, hospital-acquired, healthcare-associated (2,3).

- Microbiology: classified according to international standards (11).

Hospital mortality was the primary outcome, it was determined using information from the medical records

Bias: As a retrospective study, potential bias was related to data quality.

Sample size: Convenience sampling including all eligible patients (n=400).

Statistical analysis:

For qualitative variables, absolute and relative frequencies were calculated and are presented in tables. In the bivariate analysis, numerical variables were analyzed using Student's t-test or the Mann–Whitney U test according to their distribution, which was assessed using the Shapiro–Wilk test. For categorical variables, Pearson's chi-square test or Fisher's exact test was applied based on the obtained values. Differences in mortality among categorical variables were analyzed using the log-rank test and Kaplan–Meier curves, which were censored at 60 days of hospitalization, given that only 6.2% of patients (25) had a length of stay longer than 60 days. A forward stepwise logistic regression was performed to evaluate risk factors associated with mortality. Statistical significance was set at $p < 0.05$. All statistical analyses were conducted using Stata version 16.1 (StataCorp, TX, USA).

RESULTS

In this cohort, a population of community-dwelling adults aged ≥ 65 years was identified, predominantly characterized by being male, having a marital status of married or widowed, presenting multiple comorbidities, and exhibiting some degree of dependence in activities of daily living. Table 1 summarizes the clinical and sociodemographic characteristics of the study population.

Table 1
Clinical and demographic characteristics of the study population

Sex	**n**	**%**
Female	162	40.5
Male	238	59.5
Age (years)		
Median	74	
Interquartile range	69–80	
Age group		
65–74	217	54.3
75–84	148	37.0
≥ 85	35	8.7
Weight (kg)		
Median	60	
Interquartile range	51–70	
Height (m)		
Average	1.60	
Standard deviation	0.08	
CI95%	1.59–1.61	
Body mass index (BMI)		
Underweight	131	34.2
Normal weight	193	50.4
Overweight	39	10.2
Obesity	20	5.2
Area		
Urban	251	62.8
Rural	149	37.2
Institutionalized in long-term care facilities		

Sex	n	%		
Yes	18	4.5		
No	382	95.5		
Marital status				
Single	99	24.7		
Married	222	55.5		
Cohabiting	20	5.0		
Widowed	42	10.5		
Separated	17	4.3		
Barthel Index				
Total dependence	10	2.5		
Severe dependence	33	8.3		
Moderate dependence	70	17.5		
Mild dependence	169	42.4		
Total independence	117	29.3		
Charlson Comorbidity Index				
Low risk	0	0.0		
Moderate risk	24	6.0		
High risk	132	33.0		
Very High risk	244	61.0		
Comorbidities				
Diabetes			132	33.0
Heart failure			115	28.8
Chronic kidney disease			99	24.8
Ischemic heart disease	98	24.5		
Pulmonary disease	96	24.0		
COVID-19	61	15.3		

Sex	n	%
Peripheral vascular disease	57	14.3
Neoplasm	50	12.5
Peptic ulcer disease	36	9.0
Cerebrovascular disease	33	8.3
Liver disease	21	5.3
Dementia	16	4.0
Connective tissue disease	9	2.3
HIV	5	1.3
Delirium		
Yes	243	60.8
No	157	39.2
Immunosuppression		
Yes	159	39.8
No	241	60.2
Condition causing immunosuppression		
None	241	60.2
Malnutrition	127	31.8
Alcoholism	18	4.5
Homelessness	5	1.2
Incarceration	4	1.0
Tuberculosis	3	0.8
Depression	2	0.5
Length of hospital stay (days)		
Median	18	
Interquartile range	10–33	
Type of microorganism		

Sex	n	%
Gram-negative	236	81.7
Gram-positive	48	16.6
Fungus	5	1.7
Source of infection		
Respiratory	101	25.3
Genitourinary	89	22.3
Abdominal	88	22.0
Devices/catheters	36	9.0
Unknown source	35	8.7
Soft tissue	18	4.5
Osteomuscular	15	3.7
Bloodstream	9	2.3
Central nervous system	3	0.7
COVID-19		
Yes	61	15.2
No	339	84.8

The cumulative mortality was 45% (180 patients). Mortality by age group was 47% in the 65–74 years group, 39.8% in the 75–84 years group, and 54.2% in the ≥ 85 years group. Table 2 presents the factors associated with in-hospital mortality; significant differences were found with sex, nutritional status, presence of immunosuppression, the source of bacteremia, and COVID-19 infection.

Table 2
Factors associated with in-hospital mortality

	Died (n: 180)		No died (n: 220)		*P*
	n	%	N	%	
Sex					**0.039***
Female	83	51.2	79	48.8	
Male	97	40.8	141	59.2	
Age (years)					0.669†
Median	74		74		
Interquartile range	68.5–79		69–80		
Age group					0.207*
65–74	102	47.0	115	53.0	
75–84	59	39.9	89	60.1	
≥ 85	19	54.3	16	45.7	
Body mass index (BMI)					**0.001***
Underweight	71	54.2	60	45.8	
Normal weight	65	33.7	128	66.3	
Overweight	17	43.6	22	56.4	
Obesity	12	60.0	8	40.0	
Area					0.670*
Urban	115	45.8	136	54.2	
Rural	65	43.6	84	56.4	
Institutionalized in long-term care facilities					0.961*
Yes	8	44.4	10	55.6	
No	172	45.0	210	55.0	

* Chi-square test

† Mann–Whitney U test

‡ Fisher's exact test

¥ Student's t-test

Marital status					0.889*
Single	44	44.4	55	55.6	
Married	102	45.9	120	54.1	
Cohabiting	10	50.0	10	50.0	
Widowed	16	38.1	26	61.9	
Separated	8	47.1	9	52.9	
Barthel Index					0.536‡
Total dependence	6	60.0	4	40.0	
Severe dependence	18	54.5	15	45.5	
Moderate dependence	28	40.0	42	60.0	
Mild dependence	78	46.2	91	53.8	
Total independence	50	42.7	67	57.3	
Charlson Comorbidity Index					0.128*
Low risk	11	45.8	13	54.2	
Moderate risk	50	37.9	82	62.1	
High risk	119	48.8	125	51.2	
Delirium					0.339*
Yes	114	46.9	129	53.1	
No	66	42.0	91	58.0	
Immunosuppression					**< 0.001***
Yes	88	55.3	71	44.7	
No	92	38.1	149	61.9	
Type of microorganism					0.498‡
Gram-negative	108	45.8	128	54.2	
Gram-positive	26	54.2	22	45.8	
* Chi-square test					
† Mann–Whitney U test					
‡ Fisher's exact test					
¥ Student's t-test					

Fungus	3	60.0	2	40.0	
Source of infection					**< 0.001‡**
Respiratory	56	55.5	45	44.5	
Genitourinary	22	24.7	67	75.3	
Abdominal	6	33.3	12	66.7	
Devices/catheters	5	33.3	10	66.7	
Unknown source	52	59.1	36	40.9	
Soft tissue	1	33.3	2	66.7	
Osteomuscular	2	33.3	4	66.7	
Bloodstream	7	77.8	2	22.2	
Central nervous system	14	38.9	22	61.1	
Source of infection	15	42.9	20	57.1	
Classification of bacteremia					0.062*
Community-acquired	115	47.9	125	52.1	
Hospital-acquired	52	37.7	86	62.3	
Healthcare-associated	13	59.1	9	40.9	
COVID-19					**0.001***
Yes	39	63.9	22	36.1	
No	141	41.6	198	58.4	
* Chi-square test					
† Mann–Whitney U test					
‡ Fisher's exact test					
¥ Student's t-test					

Isolation of Gram-negative bacilli was documented in 78.5% (n = 314), Gram-positive cocci in 19.8% (n = 79), and fungi in 1.8% (n = 7). The three main etiologic agents were *Escherichia coli* (28%), *Klebsiella pneumoniae* (18.3%), and *Staphylococcus aureus* (12%).

Evaluating the impact of the COVID-19 pandemic, a greater association with mortality was observed in 2021 among the study years ($p < 0.001$). See Table 3.

Table 3
COVID-19–related mortality

Yeas	COVID-19	Died (n: 180)		No Died (n: 220)		*P*
		n	%	N	%	
2020						0.261*
	Yes	8	53.3	7	46.7	
	No	31	37.8	51	62.2	
2021						**0.008***
	Yes	26	68.4	12	31.6	
	No	31	41.9	43	58.1	
2022						0.400‡
	Yes	5	62.5	3	37.5	
	No	37	46.8	42	53.2	
2023						
	Yes	0	0.0	0	0.0	NA
	No	42	40.3	62	59.7	
* Chi-square test						
‡ Fisher’s exact test						

Table 4 shows that, in the 65–74 years age group, there is a statistically significant association with higher mortality in patients with a concurrent diagnosis of bacteremia and COVID-19

Table 4
COVID-19–related mortality by age group

Age Group	COVID-19	Died (n: 180)		No Died (n: 220)		*P*
		n	%	N	%	
65–74						**< 0.001***
	Yes	31	70.5	13	29.5	
	No	71	41.0	102	59.0	
75–84						0.468*
	Yes	7	43.8	9	56.2	
	No	52	39.4	80	60.6	
≥ 85						
	Yes	1	100.0	0	0.0	0.543‡
	No	18	52.9	16	47.1	
* Chi-square test						
‡ Fisher's exact test						

Table 5 presents the logistic regression model. Variables independently associated with mortality were immunosuppression, a high Charlson Comorbidity Index (≥ 3 points), COVID-19 during hospitalization, and an abdominal source of infection.

Table 5
Logistic regression model – Factors associated with mortality

Female sex	**Crude OR**	**IC95%**	***P***	**Ajd. OR**	**IC95%**	***P***
	1.52	**1.02–2.28**	**0.038**	**1.45**	**0.93–2.26**	**0.095**
Immunosuppression	2.00	1.33–3.01	< 0.001	1.68	1.08–2.61	**0.021**
COVID-19	2.48	1.41–4.38	0.001	2.38	1.24–4.55	**0.009**
High Charlson Comorbidity Index	1.48	0.98–2.22	0.073	1.74	1.10–2.73	**0.016**
Healthcare-associated bacteremia	1.82	0.76–4.37	0.172	1.50	0.54–4.14	0.434
Respiratory source	1.75	1.11–2.76	0.014	1.83	0.98–3.42	0.055
Genitourinary source	0.31	0.18–0.54	< 0.001	0.56	0.28–1.14	0.116
Abdominal source	2.07	1.28–3.35	0.002	2.52	1.27–4.99	**0.008**
Bloodstream source	4.41	0.90–21.50	0.045	6.22	1.11–34.8	**0.037**

Figure 1 shows the differences in time to mortality between the abdominal source and other sources of infection.

Figure 2 shows the differences in mortality among patients with COVID-19.

Finally, when evaluating mortality in relation to bacteremia and microbiological isolates with antibiotic resistance, no statistically significant associations were found, suggesting that resistance was not a determinant of mortality in this cohort. However, some non-significant trends were observed, including higher mortality among patients with isolates exhibiting resistance patterns such as AmpC and organisms such as Pseudomonas

DISCUSSION

A cumulative mortality of 45% was observed, which is consistent with that reported in the population-based study by Laupland et al.(3) and approaches the 50% mortality described in the multicenter study by Hoffmann et al. (9). No statistically significant differences were found between age groups and mortality proportion, which differs from the findings of Laupland et al. (3), who reported an increase in mortality with advancing age. This discrepancy may be explained by the characteristics of our cohort, in

which more than 50% of the study population was concentrated in the youngest age group, limiting the ability to detect statistically significant differences in the other age groups.

Independent factors associated with mortality were female sex, an abdominal source of infection, low body mass index, immunosuppression, and the presence of COVID-19. These findings are consistent with previous international studies by Hoffmann et al. (9), who reported worse survival among patients with low body mass index and an abdominal source. Additionally, the coexistence of COVID-19 was associated with higher mortality, in agreement with findings previously described by Comoglu et al. (13).

These findings may be explained by the physiological conditions inherent to aging, which differ from those observed in cohorts of younger adults, as well as by the emergence of the COVID-19 pandemic, which, as previously noted, increased individual mortality and whose impact declined over time, with the greatest effect observed in 2021 in the study population (14–16). Additionally, malnutrition, assessed by body mass index, showed that underweight patients had higher mortality, which may be explained by reduced functional reserve and a diminished capacity to respond to physiological stressors (9, 10).

The results of the logistic regression model show that female sex was associated with a higher risk of mortality, a finding that is not consistent with previous studies (3, 9), and may be related to variables not included in this cohort as well as differences in nutritional status. The presence of immunosuppression and the coexistence of COVID-19 were the two factors most strongly associated with mortality, increasing the risk of death by nearly twofold and threefold, respectively, thus carrying greater prognostic weight in this cohort (9, 15).

Patients with a genitourinary source showed better survival, whereas those with pulmonary and abdominal sources had higher mortality, a pattern consistently reported in international studies (2, 3, 9). These findings may be explained by the microorganisms responsible for genitourinary bacteremia, which are predominantly enterobacteria—organisms with more predictable resistance patterns that typically respond well to initial empiric antibiotic therapy. In addition, the genitourinary source is often readily identifiable and controllable, facilitating faster resolution of the infectious process (17). In contrast, bacteremia of pulmonary and abdominal origin is associated with an increased systemic inflammatory response, hypoxemia, high bacterial load, and difficulty in achieving source control—factors that increase the risk of severe sepsis and mortality (9, 18). This helps explain the higher mortality observed in patients with reduced physiological reserve (3, 18).

In the microbiological evaluation, a higher prevalence of infections caused by Gram-negative bacteria was observed, with a notable predominance of *Escherichia coli* and *Klebsiella pneumoniae*, consistent with findings reported in international series (3, 9). A significant prevalence of Gram-positive organisms was also observed, particularly *Staphylococcus aureus*, which correlates with the findings reported by Leibovici-Weissman et al. (2) in adults aged ≥ 65 years. However, in this cohort, no statistically significant association was found between antimicrobial resistance patterns and mortality due to bacteremia, as has been demonstrated in other studies (19). This may be explained by the relatively small sample size analyzed.

Regarding the assessment of geriatric indices (10, 15), no significant differences in mortality were found in the multivariate analyses for the Barthel and Charlson indices. However, this finding should be interpreted with caution, as international studies have shown that a high Charlson score (≥ 3 points) is associated with increased mortality (3, 20). This result may be explained by a ceiling effect in this cohort, given that most of the study population had high Charlson index scores (12, 15). These findings suggest that the assessment should include variables such as frailty and systematically report the Barthel index, allowing for a more accurate evaluation of baseline status in adults aged ≥ 65 years.

LIMITATIONS

This is a retrospective study based on secondary data, which may introduce biases in data collection. Second, the sample size is relatively small, and for some variables, this limited statistical power may have precluded the detection of significant associations. Third, it was not possible to include variables such as frailty, which would have contributed to a more comprehensive characterization of the geriatric population and allowed for additional associations with mortality to be assessed. Finally, the Barthel Index was not available for 100% of the sample, which limits its interpretation

CONCLUSIONS

In this cohort of adults aged ≥ 65 years with bacteremia, a high mortality rate was observed, similar to that reported in the international literature, primarily driven by individual clinical factors such as the presence of immunosuppression, an abdominal source of infection, and COVID-19 during hospitalization.

Nutritional status was also found to be associated with higher mortality, whereas geriatric indices did not show statistically significant differences. A ceiling effect was inferred for the Charlson Comorbidity Index, as most of the population had a high burden of comorbidities.

Finally, this cohort was characterized by a high prevalence of bacteremia of predominantly community-acquired respiratory origin, with Gram-negative bacilli—particularly *Escherichia coli*—being the most frequently isolated pathogens. No statistically significant association was found between antimicrobial resistance patterns and mortality due to bacteremia.

Recommendations

A longitudinal, prospective cohort approach is recommended in a future study period, incorporating additional geriatric variables such as frailty and the systematic assessment of the Barthel Index in all patients. This would allow for a better understanding of the associations between clinical outcomes and characteristics of the geriatric population. Furthermore, including variables such as leukocytosis and serum levels of acute-phase reactants would help evaluate the immune response in adults aged ≥ 65 years.

Abbreviations

IDSA: Infectious Diseases Society of America

COVID19: Coronavirus Disease of 2019

BMI: Body mass index

HIV: Human immunodeficiency virus

Declarations

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Not applicable.

Authors' contributions

AMMG conceived and designed the study, collected data, conducted the statistical analysis, drafted the manuscript, contributed to revision and approval of the final manuscript, and agrees to be accountable for the accuracy and integrity of the work. FAG collected data, conducted the statistical analysis, contributed to revision and approval of the final manuscript, and agrees to be accountable for the accuracy and integrity of the work. DASR collected data, contributed to revision and approval of the final manuscript, and agrees to be accountable for the accuracy and integrity of the work. JSVG contributed to revision and approval of the final manuscript, and agrees to be accountable for the accuracy and integrity of the work. All authors have read and approved the manuscript.

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Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due institutional research ethics agreement but may be available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the University of Caldas (Act CBCS-059, November 25, 2025) and the Research Committee of the Santa Sofía Departmental Hospital. Informed consent was considered unnecessary in accordance with the national regulations Resolution 8430 of 1993 of the Ministry of Health of Colombia and was classified as research without risk in accordance with Resolution 8430 of 1993 of the Ministry of Health of Colombia.

Clinical trial number

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

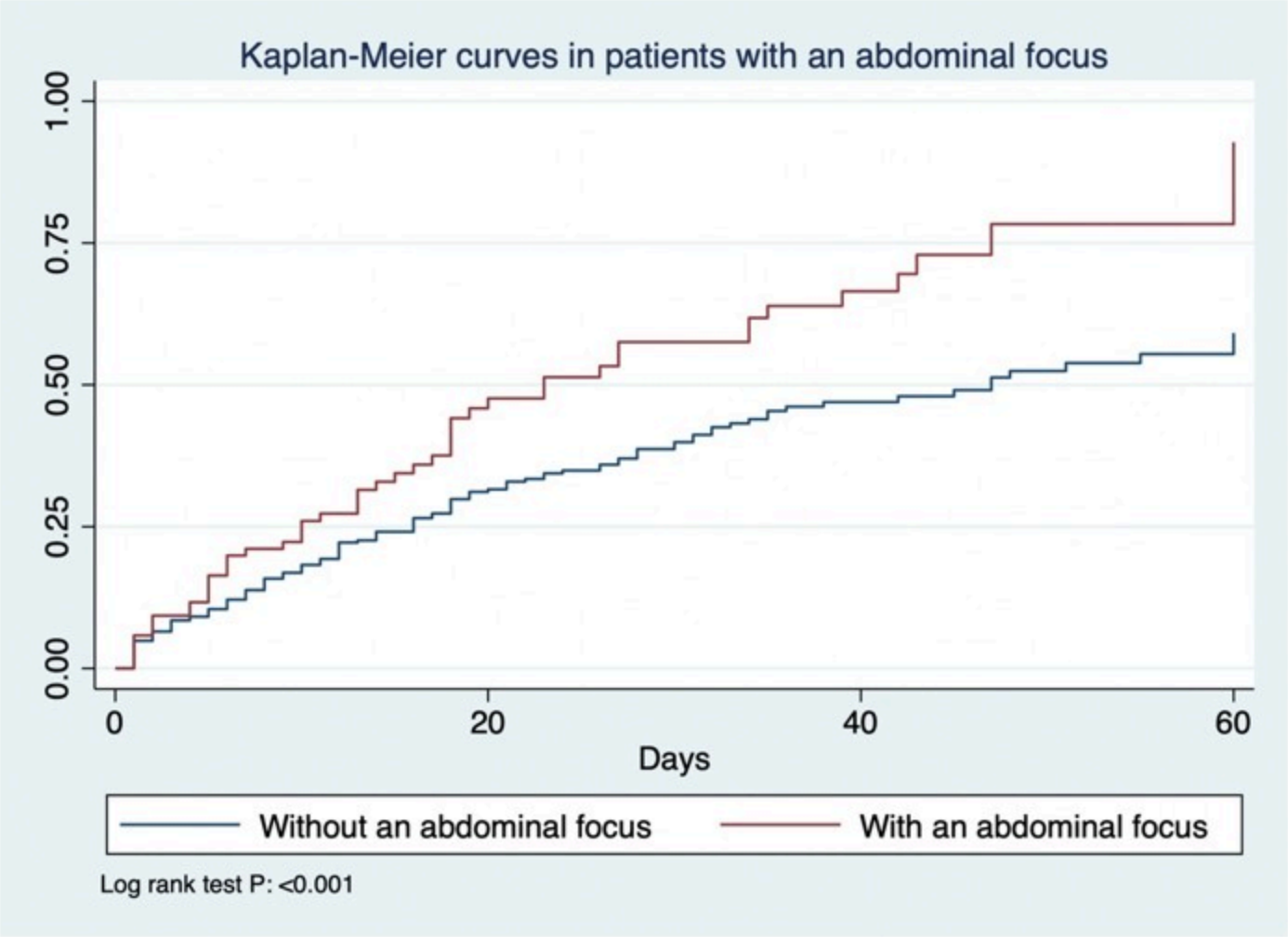


Figure 1

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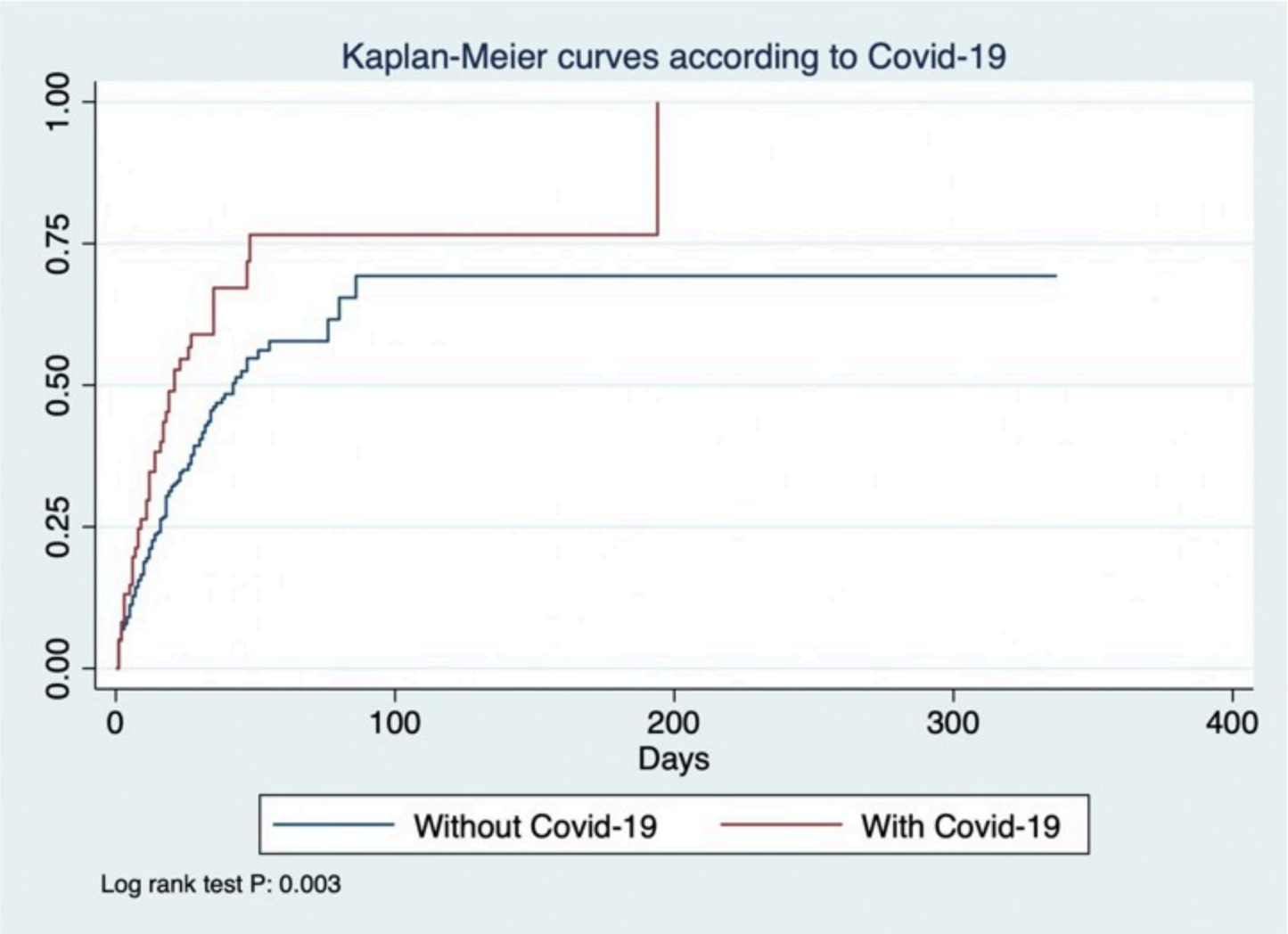


Figure 2

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