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RESEARCH ARTICLE

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PERT era, race-based healthcare disparities in a large urban safety net hospital

Veena H. Dronamraju[1] | **Ka U. Lio**[2] | **Rohan Badlani**[2] | **Ke Cheng**[3] | **Parth Rali**[1]

[1]Department of Thoracic Medicine and Surgery, Lewis Katz School of Medicine at Temple University, Philadelphia, Pennsylvania, USA

[2]Department of Medicine, Lewis Katz School of Medicine at Temple University, Philadelphia, Pennsylvania, USA

[3]Department of Clinical Sciences, Lewis Katz School of Medicine at Temple University, Philadelphia, Pennsylvania, USA

Correspondence
Veena H. Dronamraju, Mount Auburn Hospital, 330 Mt. Auburn St., Cambridge, MA 02138, USA.
Email: VDronamraju@gmail.com

Present address
Veena H. Dronamraju, Department of Pulmonary and Critical Care Medicine, Mount Auburn Hospital, Cambridge, Massachusetts, USA.

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Abstract

Pulmonary embolism (PE) is the third leading cause of cardiovascular death in the United States. Black Americans have higher incidence, greater clot severity, and worse outcomes than White Americans. This disparity is not fully understood, especially in the context of the advent of PE response teams (PERT), which aim to standardize PE-related care. This retrospective single-center cohort study compared 294 Black and 131 White patients from our institution's PERT database. Primary objectives included severity and in-hospital management. Secondary outcomes included length of stay, 30-day readmission, 30-day mortality, and outpatient follow-up. Clot ($p = 0.42$), acute treatment ($p = 0.28$), 30-day mortality ($p = 0.77$), 30-day readmission ($p = 0.50$), and outpatient follow-up ($p = 0.98$) were similar between races. Black patients had a lower mean household income ($35,383, SD 20,596) than White patients ($63,396, SD 32,987) ($p < 0.0001$). More Black patients (78.8%) had exclusively government insurance (Medicare/Medicaid) compared to White patients (61.8%) ($p = 0.006$). Interestingly, government insurance patients had less follow-up (58.3%) than private insurance patients (79.7%) ($p = 0.001$). Notably, patients with follow-up had fewer 30-day readmissions. Specifically, 12.2% of patients with follow-up were readmitted compared to 22.2% of patients without follow-up ($p = 0.008$). There were no significant differences in PE severity, in-hospital treatment, mortality, or readmissions between Black and White patients. However, patients with government insurance had less follow-up and more readmissions, indicating a socio-economic disparity. Access barriers such as health literacy, treatment cost, and transportation may contribute to this inequity. Improving access to follow-up care may reduce the disparity in PE outcomes.

KEYWORDS
outpatient follow-up, pulmonary embolism, race, social determinants of health, venous thromboembolism

INTRODUCTION

Pulmonary embolism (PE) is the third leading cause of cardiovascular death in the United States. The Centers for Disease Control and Prevention estimate that it causes 60,000–100,000 deaths per year in this country.[1] Understanding the impact of any disease in the United States would be incomplete without a discussion of healthcare disparities. Investigating this relationship helps providers identify inequalities while working to deliver equitable care to patients. Black Americans have higher incidence of venous thromboembolism,[2] are nearly twice as likely to be hospitalized for PE[3] and have a 50% higher age-related mortality from PE[4] compared to White Americans. Phillips et al. performed a large study ($n = 8743$) demonstrating that Black patients with PE presented at younger age had higher severity of clot and lower rates of PE-specific interventions in cases of intermediate severity clot.[5]

Notably, our institution has a formalized PE response team (PERT), which was established in 2017 to standardize treatment. This multidisciplinary team led by pulmonary and critical care includes the primary team, interventional and diagnostic radiology, interventional cardiology, nuclear medicine, hematology, and cardiovascular surgery. PERT is activated by the emergency department or primary team for every acute PE seen on any imaging modality, regardless of severity of clot. In this study, we hypothesize that the use of PERT in a safety net hospital with notable diversity may standardize care and reduce rates of racial disparities related to PE.

METHODS

We conducted a single-center retrospective review of all patients between January 2017 and June 2020 at our institution who underwent PERT evaluation and included all cases of acute PE diagnosed by computed tomography pulmonary angiography. Approximately 5% of all acute PE cases were diagnosed by other imaging modalities and were excluded from the study. Cases of pulmonary infarction were identified by review of the final CT reports. Our study met approval by the Institutional Review Board (Protocol #26021) and informed consent was waived due to the retrospective nature of the study. The electronic health record was reviewed and patients who self-identified as White or Black were included in the study. Patient records were excluded if any other race was recorded or if race was omitted from the chart. Patient selection process is shown in Figure 1.

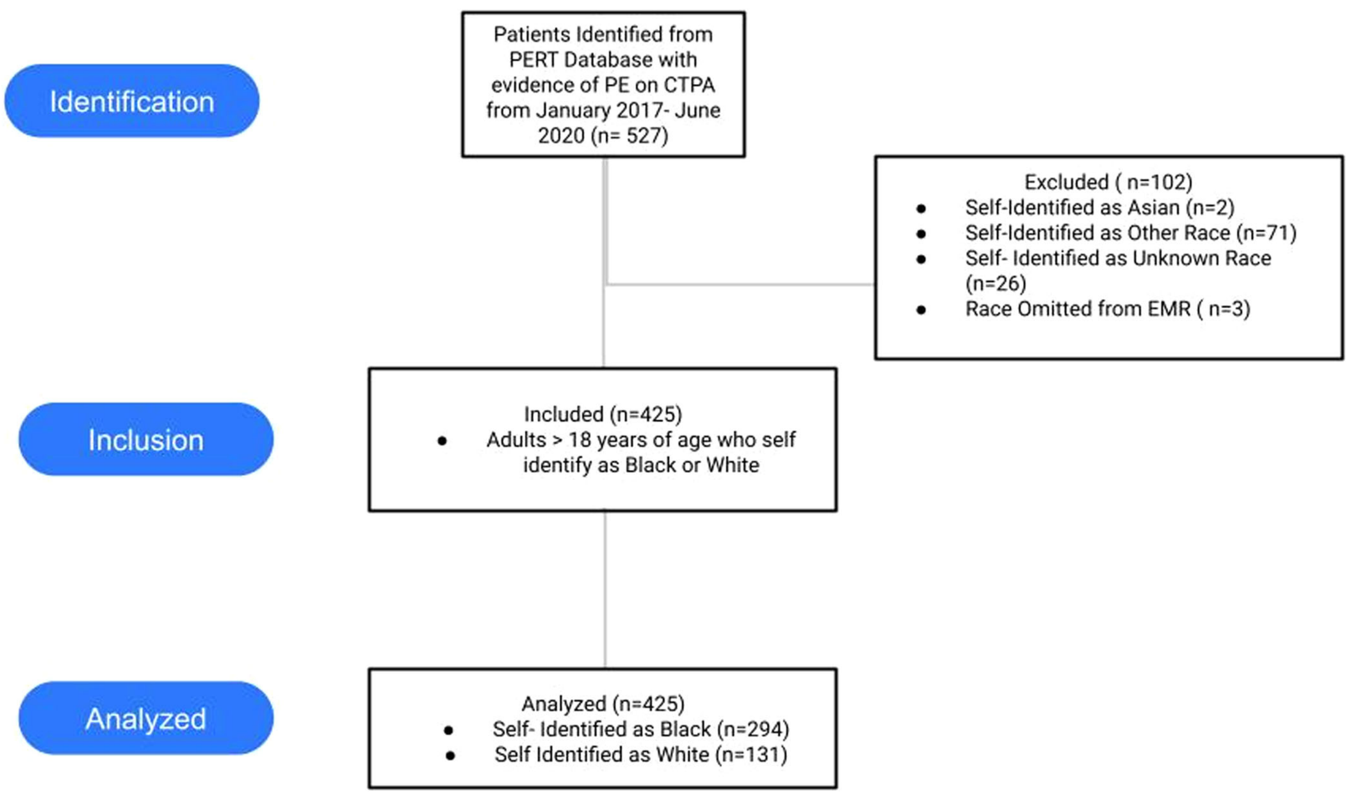

FIGURE 1 Patient selection process.

Electronic health records were reviewed for demographics, type of health insurance, body mass index (BMI), zip code, severity of PE based on the European Society of Cardiology guidelines, and treatment course (anticoagulation catheter-directed therapy, systemic thrombolysis, thrombectomy). Past medical history was reviewed for hypothyroidism, deep vein thrombosis, malignancy, diabetes mellitus, chronic obstructive pulmonary disease, cardiopulmonary disease, current anticoagulation use before admission, and inferior vena cava filter.

Primary analysis evaluated differences in severity of PE, choice of treatment modalities, comorbidities, socioeconomics, and risk factors for embolic events between Black and White patients. Secondary analysis investigated length of stay, 30-day mortality, 30-day readmission, and outpatient follow-up. Descriptive analysis and comparison were performed using Pearson's chi-squared test or analysis of variance. Alpha level was defined at 0.05. Multiple regression was performed for severity of clot, initial treatment choice, any-doctor follow-up, specialist follow-up, 30-day mortality, and 30-day readmission using stepwise selection. All statistics were completed using Statistical Analysis Software 9.4.

RESULTS

A total of 527 patients were identified with a diagnosis of PE during their admission by computed tomography pulmonary angiography. A total of 425 patients met inclusion criteria based on race. 131 (30.8%) patients self-identified as White and 294 (69.2%) as Black. There were no statistically significant differences in the mean age, sex, or mean BMI between the two cohorts. Black patients tended to live slightly closer to the hospital than White patients with a median distance of 2.0 miles (range 0–515 miles) compared to 5.8 miles (range 0–313 miles) ($p = 0.001$). While there was no difference in rates of employment ($p = 0.32$) and insurance status between the two groups ($p = 0.47$), 220 (74.8%) Black compared to 81 (61.8%) White patients had exclusively government insurance (Medicare, Medicaid) ($p = 0.0006$). The mean household income determined by home zip code data was notably lower for Black patients ($35,583, SD 20596) than White patients ($63,596, SD 32987) ($p < 0.0001$). 139 (47.3%) Black patients were below the poverty line compared to 11 (8.40%) White patients ($p < 0.0001$) (Table 1).

Rates of comorbidities including malignancy, diabetes mellitus, chronic obstructive pulmonary disease, cardiopulmonary disease, previous or current deep venous thrombosis, recent surgical history, and anticoagulation before admission were not statistically different between the groups. A total of 11 (3.7%) Black patients had hypothyroidism compared to 14 (10.7%) White patients ($p = 0.005$). (Table 2). Distribution of severity of PE did not vary by race (Figure 2). In-hospital treatment choices were compared and there were no

TABLE 1 Population demographics by race.

	White (N = 131)	Black (N = 294)	p Value
Age, mean (SD)	60.2 (16.2)	59.5 (16.6)	0.59
Female sex, N (%)	64 (48.9)	168 (57.1)	0.11
Body mass index, mean (SD)	31.8 (9.00)	32.3 (9.70)	0.58
Median distance from hospital, N (range)	5.8 (0, 343)	2.0 (0, 515)	0.001
Employed, N (%)	34 (26.0)	65 (22.1)	0.46
Insured, N (%)	127 (96.9)	276 (93.9)	0.42
Government insurance, N (%)	81 (61.8)	220 (74.8)	<0.001
Mean family income in US dollars by zip code, N (SD)	63,596 (32,987)	35,583 (20,596)	<0.001
Below poverty line, N (%)	11 (8.40)	139 (47.3)	<0.001

TABLE 2 Population comorbidities by race.

	White (N = 131)	Black (N = 294)	p Value
Hypothyroidism, N (%)	14 (10.7)	11 (3.7)	0.005
Deep venous thrombosis, N (%)	24 (18.3)	53 (18.0)	0.94
Malignancy history, N (%)	35 (26.7)	71 (24.1)	0.57
Diabetes mellitus, N (%)	29 (22.1)	80 (27.2)	0.27
Chronic obstructive pulmonary disease, N (%)	16 (12.2)	46 (15.6)	0.35
Cardiopulmonary history, N (%)	38 (29.0)	103 (35.0)	0.22
Recent surgery history, N (%)	21 (16.0)	41 (13.9)	0.57
Anticoagulation before admission, N (%)	19 (14.5)	34 (11.6)	0.40
Previous IVC filter, N (%)	11 (2.6)	6 (4.6)	0.08

Abbreviation: IVC, inferior vena cava.

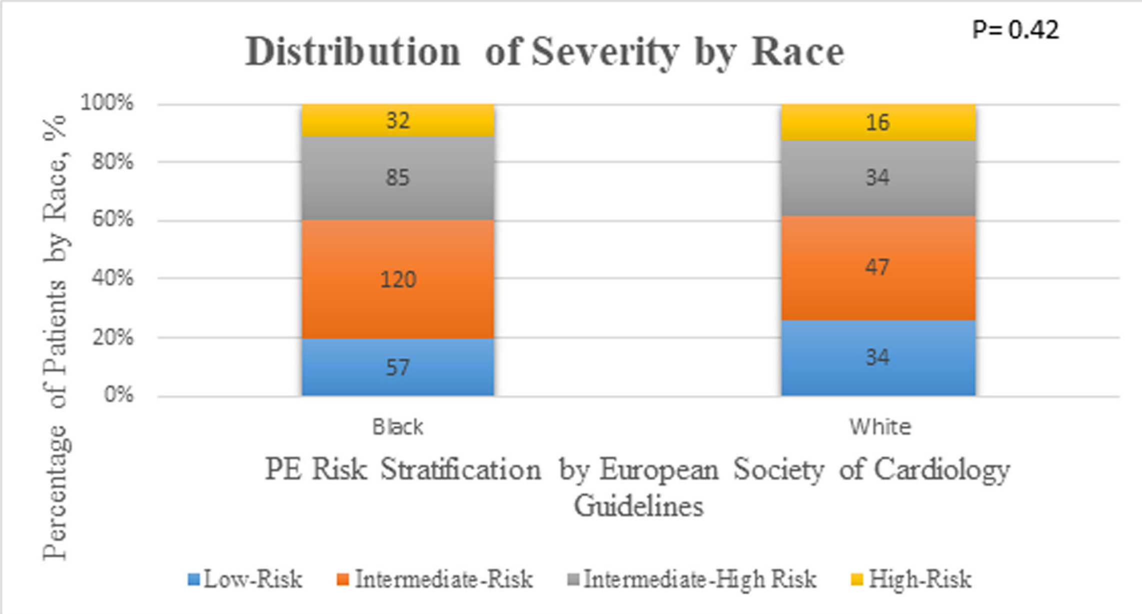

FIGURE 2 Distribution of severity of clot by race.

statistically significant differences in rates of anticoagulation prescribed, catheter-directed therapy, systemic thrombolysis, and thrombectomy (Table 3).

The analysis was repeated comparing Black ($n = 139$) and White ($n = 11$) patients who were below the poverty line and then Black ($n = 155$) and White patients ($n = 120$) who were above the poverty line to adjust for socioeconomic status. Among those below the poverty line, there were no significant differences between the races—including distance from the hospital, mean family income by zip code, rates of hypothyroidism, severity of clot, or initial treatment choice. Among those above the poverty line, Black patients had a lower mean income by zip code with a value of $48,856 (SD 20,347) compared to $56,960 (SD 27,522) in White patients ($p < 0.0001$). Black patients also had higher rates of hypothyroidism (13 (10.8%) versus 7 (4.5%); $p = 0.045$).

Multiple regression was performed and demonstrated that only history of cardiopulmonary disease was independently associated with higher severity of clot with an odds ratio (OR) of 1.48 (Wald 95% confidence interval [CI] 1.020–2.13; $p = 0.039$). Multiple regression demonstrated an independent association of BMI (OR 0.97, Wald 95% CI 0.95–0.99, $p = 0.003$), malignancy history (OR 2.27, Wald 95% CI 1.45–3.56, $p = 0.000$), and no previous inferior vena cava filter (OR 9.51, Wald 95% CI 2.58–34.98, $p = 0.001$) with initial treatment choice of anticoagulation. Lack of recent surgical history was independently associated with initial treatment choice of surgical thrombectomy (OR 8.28, Wald 95% CI 1.81–37.9, $p = 0.001$). Regression could not be performed with the other in-hospital treatment choices due to lack of significant predictors in the model (Table 4).

TABLE 3 In-hospital treatment by race.

	White ($N = 131$)	Black ($N = 294$)	p Value
Anticoagulation alone, N (%)	61 (46.6)	169 (57.5)	0.07
Anticoagulation with second intervention, N (%)	34 (26.0)	52 (17.7)	0.07
Catheter-directed therapy, N (%)	21 (16.0)	33 (11.2)	0.17
Systemic thrombolysis, N (%)	9 (6.90)	16 (5.40)	0.22
Mechanical thrombectomy, N (%)	1 (0.80)	7 (2.40)	0.26
Surgical thrombectomy, N (%)	1 (0.80)	6 (2.00)	0.34

Secondary analysis was performed looking at post-discharge outcomes. The mean length of stay was 9.2 days for Black patients and 12.6 days for White patients ($p = 0.026$). A total of 18 (6.10%) Black patients and nine (6.90%) White patients died within 30-days of admission ($p = 0.77$). A total of 230 (54.1%) Black and 71 (54.2%) White patients had any doctor follow-up ($p = 0.98$). A total of 210 (49.4%) Black and 65 (49.6%) White patients had specialist follow-up ($p = 0.95$). There

TABLE 4 Multiple regression analysis of primary outcomes: Severity of clot and initial treatment management.

	Odds ratio	95% Confidence interval	*p* Value
Severity of clot			
Cardiopulmonary disease	1.48	1.02–2.13	0.039
Anticoagulation			
BMI	0.97	0.95–0.99	0.003
Malignancy	2.27	1.45–3.56	<0.001
No previous IVC filter	9.51	2.58–34.98	0.001
Surgical thrombectomy			
No recent surgical history	8.28	1.81–3 37.93	0.001

Abbreviations: BMI, body mass index; IVC, inferior vena cava.

TABLE 5 Comparison of out-patient follow-up, length of stay, in-hospital mortality, and 30-day readmission rates by race.

	White ($N = 131$)	Black ($N = 294$)	*p* Value
Any doctor follow-up, *N* (%)	230 (54.1)	71 (54.2)	0.98
Specialist follow-up, *N* (%)	210 (49.4)	65 (49.6)	0.95
Mean length of stay, days (SD)	12.6 (15.7)	9.2 (10.9)	0.026
30-day mortality, *N* (%)	9 (6.90)	18 (6.10)	0.77
30-day readmission rate, *N* (%)	27 (18.0)	38 (13.8)	0.52

were 38 (13.8%) readmissions within 30-days for Black patients and 27 (18.0%) for White patients ($p = 0.50$) (Table 5). Reasons for readmission had the following breakdown: 45 (69.2%) unrelated medical cause, nine (13.8%) atypical chest pain, seven (10.8%) acute blood loss anemia, one (1.5%) unable to afford anticoagulation, one (1.5%) acute deep venous thrombosis, one (1.5%) acute hypercapnic respiratory failure, and one (1.5%) non-ST-elevation myocardial infarction.

A total of 30-day readmission rates were significantly associated with female sex ($p = 0.003$), history of malignancy ($p = 0.0003$), diabetes mellitus ($p = 0.022$), and chronic obstructive pulmonary disease ($p = 0.043$). Mean household income of those readmitted to the hospital was significantly lower ($37,687, SD 22,974) than those who were not readmitted ($45,319, SD 27,710) ($p = 0.021$). Patients who had outpatient follow-ups scheduled with any doctor (cardiology, hematology, pulmonology, primary care) had lower 30-day readmission rates; Only 28 (12.2%) patients with any doctor follow-up were readmitted compared to 37 (22.1%) of those without follow-up ($p = 0.008$). A total of 54 (19.1%) patients with exclusively government insurance compared to five (7.8%) patients with exclusively private insurance were re-admitted within 30-days ($p = 0.03$). A total of 165 (58.3%) patients with exclusively government insurance were noted to have any doctor follow-up compared to 79.7% (51) of patients with private insurance ($p = 0.001$).

Multiple regression was performed and female sex, malignancy history, and lack of specialist follow-up were noted to be independently associated with 30-day readmission. The odds ratios were 2.21 for female sex (Wald 95% CI 1.20– 4.08; $p = 0.011$), 2.04 for malignancy history (Wald 95% CI 1.108–3.758; $p = 0.022$), and 0.46 for specialist follow-up (Wald 95% CI 0.256–0.828; $p = 0.009$). A total of 30-day mortality was associated with diabetes (OR 2.05, Wald 95% CI 1.00–4.22; $p = 0.051$), cardiopulmonary disease (OR 2.80, Wald 95% CI 1.37–5.73; $p = 0.005$), and high-risk clot compared to low-risk clot (OR 5.08, Wald 95% CI 1.86–13.86; $p = 0.002$). Specialist follow-up was associated with female sex (OR 1.66, Wald 95% CI 1.15–2.40; $p = 0.007$), employment (OR 2.3, Wald 95% CI 1.38–3.82; $p = 0.001$), having insurance (OR 3.95, Wald 95% CI 1.66–9.38; $p = 0.002$), malignancy history (OR 1.24, Wald 95% CI 1.55–3.77; $p = 0.001$), and intermediate-high-risk clot compared to low-risk clot (OR 1.77, Wald 95% CI 1.05–1.86; $p = 0.033$). Any doctor follow-up was associated with employment (OR 2.27, Wald 95% CI 1.37–3.76; $p = 0.002$), having insurance (OR 4.08, Wald 95% CI 1.74–9.61; $p = 0.001$), malignancy history (OR 2.33, Wald 95% CI 1.50–3.62; $p = 0.000$) and intermediate-high-risk versus low-risk clot (OR 1.75, Wald 95% CI 1.04–2.94; $p = 0.035$) (Table 6).

DISCUSSION

In this study, we found that there was no difference in comorbidities, severity of PE on presentation, rates of advanced therapy (catheter-directed thrombolysis or surgical embolectomy), 30-day mortality, 30-day readmission, and outpatient follow-up between Black and White patients with PE. Female sex, history of malignancy and lack of specialist follow-up, however, were associated with a higher rate of 30-day readmission. Notably, patients with exclusively government insurance (Medicaid and/or Medicare) had lower rates of any doctor follow-up and increased 30-day readmissions.

TABLE 6 Multiple regression analysis of secondary outcomes: Follow-up, 30-day mortality, 30-day readmissions.

	Odds ratio	95% Confidence interval	*p* Value
Any doctor follow-up			
Employed	2.27	1.37–3.76	0.002
Insured	4.08	1.74–9.61	0.001
Malignancy	2.33	1.50–3.62	<0.001
High-risk vs. low-risk clot	0.693	0.35–.36	0.287
Intermediate-high-risk vs. low-risk clot	1.75	1.04–2.94	0.035
Intermediate-low-risk vs. low-risk	1.19	0.74–1.93	0.471
Specialist follow-up			
Female sex	1.66	1.15–2.40	0.007
Employment	2.3	1.38–3.82	0.001
Insured	3.95	1.66–9.38	0.002
Malignancy	1.24	1.55–3.77	0.001
High-risk vs. low-risk clot	0.66	0.034–1.31	0.237
Intermediate-high-risk vs. low-risk clot	1.77	1.05–2.99	0.033
Intermediate-low-risk vs. low-risk	1.15	0.71–1.86	0.573
30-day mortality			
Diabetes mellitus	2.05	1.00–4.22	0.051
Cardiopulmonary disease	2.8	1.37–5.73	0.005
High-risk vs. low-risk	5.08	1.86–13.86	0.002
Intermediate-high-risk vs. low-risk	0.86	0.30–2.50	0.779
Intermediate-low-risk vs. low-risk	0.58	0.21–1.64	0.305
30-day readmission			
Female sex	2.21	1.20–4.08	0.011
Malignancy	2.04	1.11–3.76	0.022
Specialist follow-up	0.46	0.26–0.83	0.010
High-risk vs. low-risk	0.63	0.20–1.98	0.428
Intermediate-high-risk vs. low-risk	0.33	0.12–0.86	0.023
Intermediate-low-risk vs. low-risk	1.17	0.58–2.36	0.670

Our results are novel in that they are contrary to existing data that Black patients with PE have higher rates of PE severity, lower rates of advanced interventions, and poorer outcomes.[3–6] The similar utilization of advanced therapy between the races is reassuring because it suggests that the quality of in-hospital care may not be markedly different between racial groups at our institution. This may be explained by our institution's utilization of PERT, which has proven to standardize PE care.[7,8] Further studies, however, still need to be completed with comparison to a cohort of patients predating PERT at our institution to completely understand the role of PERT in our data. It is also important to note that our study used the European Society of Cardiology classification as the standard of care for all patients with PE. Previous studies may have used varying definitions of the severity at presentation that may also contribute to the varying severity.

Another factor that may explain our unique results is our institution's commitment to serving its community and providing equitable care. In 2021, the Lown Institute, a nonprofit healthcare think tank, ranked our institution the most racially inclusive hospital in the state and 13th most in the nation based on Medicare claims from 2018, as well as the US Census Bureau's American Community Survey data.[9] Hospitals on this list were noted to be "especially effective" at providing care for patients of color in their surrounding communities. Previous studies noted explicit bias against Black patients and mistrust of the healthcare system as possible explanations for the disparity in care between Black and White patients.[5] These factors are associated with decreased utilization of the healthcare system. Thus, it is possible that in the previous studies, Black patients with lesser severity of clot and minimal symptoms likely did not come into the hospital, thereby explaining the higher severity at presentation compared to White patients. Furthermore, provider bias was thought to explain the disparity of care within the healthcare system.

The high 30-day readmission rate and lower rate of follow-up observed in patients with exclusively government insurance are concerning and suggest potential barriers that may influence long-term outcomes of these patients. We hypothesize that the disparities in outcomes seen with PE are partially related to low socioeconomic status rather than race alone. It is well-recognized that Medicaid and Medicare-insured patients can experience numerous barriers to receiving medical care. These include, but are not limited to, inability to navigate healthcare services, lack of access to reliable and affordable internet and mobile access, prolonged referral time to specialists, lack of public transportation, and poor psychosocial support.[10] These findings highlight the importance of identifying and addressing potential barriers that affect postdischarge care.

Race, ethnicity, and socioeconomic status are closely entwined and affect an individual's overall health.[11] In this study, while there is no difference in the rates of employment and insurance status, Black patients with PE had notably lower mean household income and more frequently lived below the poverty line when compared to White patients. These findings suggest that Black Americans could be socioeconomically disadvantaged and thus more susceptible to health inequalities, which parallels with existing evidence that Black patients are associated with shorter life expectancy and higher cardiovascular comorbidities such as myocardial infarction, stroke, and hypertension.[12–14]

There are several limitations in this study. First, the retrospective nature of the study with a considerably smaller sample size from a single center limits the power to identify disparities where they might exist. Second, this study primarily focused on Black and White populations. Other racial minority groups such as Hispanics and Asian/Pacific Islanders were not analyzed due to inadequate sample size, which limits a more granular analysis of complex interplay between race and socioeconomic status on the outcomes of PE. Third, there is no consensus in the literature on which measurement of socioeconomic status is best to use. Although we included a comprehensive list of parameters, other relevant parameters such as education status and occupation were not included in the study. Finally, while analysis was performed to adjust for socioeconomic status by comparing races below and above the poverty line, it is notable that there were only 11 White patients who had a mean family income below the poverty line. This may limit the ability to draw reliable comparisons.

CONCLUSIONS

Black populations could be socioeconomically disadvantaged and thus more susceptible to health inequalities. Disparity in outcomes seen with PE are more likely related to the socioeconomic status, rather than race alone. This study highlights the complexities of healthcare inequalities and further studies are needed to identify interventions to mitigate inequalities related to PE.

AUTHOR CONTRIBUTIONS

Veena H. Dronamraju and Parth Rali helped to conceive and design the analysis. Veena H. Dronamraju, Ka U. Lio, and Rohan Badlani helped to collect the data, perform analysis, and write the manuscript. Ke Cheng helped to perform analysis for the manuscript. All authors read and approved the final manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

ETHICS STATEMENT

Our study met approval by the Institutional Review Board (Protocol #26021). Informed consent was waived by the Institution Review Board due to the retrospective nature of the study.

ORCID

Veena H. Dronamraju http://orcid.org/0000-0002-0155-7973
Ka U. Lio http://orcid.org/0000-0003-0150-0173

REFERENCES

1. Data and Statistics on Venous Thromboembolism Centers for Disease Control and Prevention. 2022 Jun 9. https://www.cdc.gov/ncbddd/dvt/data.html
2. White RH. The epidemiology of venous thromboembolism. Circulation. 2003 Jun 17;107(23_suppl_1):I–4.
3. Martin KA, McCabe ME, Feinglass J, Khan SS. Racial disparities exist across age groups in Illinois for pulmonary embolism hospitalizations. Arterioscler Thromb Vasc Biol. 2020 Sep;40(9):2338–40.
4. Horlander KT, Mannino DM, Leeper KV. Pulmonary embolism mortality in the United States, 1979–1998: an analysis using multiple-cause mortality data. Arch Intern Med. 2003 Jul 28;163(14):1711–7.
5. Phillips AR, Reitz KM, Myers S, Thoma F, Andraska EA, Jano A, Sridharan N, Smith RE, Mulukutla SR, Chaer R. Association between black race, clinical severity, and management of acute pulmonary embolism: a retrospective cohort study. J Am Heart Assoc. 2021 Sep 7;10(17):e021818.
6. Barco S, Valerio L, Ageno W, Cohen AT, Goldhaber SZ, Hunt BJ, Iorio A, Jimenez D, Klok FA, Kucher N, Mahmoudpour SH, Middeldorp S, Münzel T, Tagalakis V, Wendelboe AM, Konstantinides SV. Age-sex specific pulmonary embolism-related mortality in the USA and Canada, 2000–18: an analysis of the WHO mortality database and of the CDC multiple cause of death database. Lancet Respir Med. 2021 Jan 1;9(1):33–42.
7. Sosa DF, Lehr AL, Zhao H, Roth S, Lakhther V, Bashir R, Cohen G, Panaro J, Maldonado TS, Horowitz J, Amoroso NE, Criner GJ, Brosnahan SB, Rali P. Impact of pulmonary embolism response teams on acute pulmonary embolism: a systematic review and meta-analysis. Eur Respir Rev. 2022 Sep 30;31(165):220023. https://doi.org/10.1183/16000617.0023-2022
8. Rali PM, Criner GJ. Submassive pulmonary embolism. Am J Respir Crit Care Med. 2018 Sep 1;198(5):588–98.
9. The Top 50 Hospitals for Racial Inclusivity, According to the Lown Institute. Advisory Board. https://www.advisory.com/daily-briefing/2021/05/27/racial-inclusivity

10. Daniel H, Bornstein SS, Kane GC. Addressing social determinants to improve patient care and promote health equity: an American College of Physicians Position Paper. Ann Intern Med. 2018 Apr 17;168(8):577–8.
11. Williams DR, Priest N, Anderson NB. Understanding associations among race, socioeconomic status, and health: patterns and prospects. Health Psychol. 2016 Apr;35(4):407–11.
12. Schwamm LH, Reeves MJ, Pan W, Smith EE, Frankel MR, Olson D, Zhao X, Peterson E, Fonarow GC. Race/ethnicity, quality of care, and outcomes in ischemic stroke. Circulation. 2010 Apr 6;121(13):1492–501.
13. Bucholz EM, Ma S, Normand SLT, Krumholz HM. Race, socioeconomic status, and life expectancy after acute myocardial infarction. Circulation. 2015 Oct 6;132(14): 1338–46.
14. Frieden TR. CDC health disparities and inequalities report-United States, 2013. Foreword. MMWR Suppl. 2013 Nov 1;62(3):1–2.

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