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# Effect of Sociodemographic Factors on Promptness of Coronary Angiography among Patients with Non-ST Elevation Myocardial Infarction: A National Inpatient Sample Analysis of the United States

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## Abstract

# Background

Early percutaneous coronary intervention (PCI) within 24 hours is the recommended standard of care for high-risk acute coronary syndromes. We aimed to quantify the impact of social, economic, and demographic factors on early PCI rates in NSTEMI patients to identify targets for public health intervention.

# Methods

Data were extracted from the National Inpatient Sample (2021). Inclusion criteria were a principal diagnosis of NSTEMI and age ≥ 18 years. Sociodemographic variables—including age, sex, race, ZIP code-inferred household income quartile, and insurance type—were analyzed using multivariable logistic regression, adjusting for hospital size, presentation severity, and the Elixhauser comorbidity index. The primary outcome was PCI within 24 hours. Analyses were conducted in STATA 18.0 (significance threshold: $p < 0.05$).

# Results

Males had significantly higher early PCI rates than females (OR 1.38, $p < 0.001$). Compared to the lowest income quartile, the third and fourth quartiles showed modestly higher intervention rates (OR 1.094, $p = 0.002$ and OR 1.102, $p = 0.003$, respectively), with no difference in the second quartile. Compared to White patients, early PCI rates were lower among Black (− 10.5%, $p = 0.002$), Hispanic (− 18%, $p < 0.001$), Asian/Pacific Islander (− 20%, $p < 0.001$), and Native American (− 32.6%, $p = 0.01$) patients. No significant differences were observed across insurance types.

# Conclusions

Significant disparities in early PCI utilization exist across sex, race, and socioeconomic status among NSTEMI patients. These findings underscore the need for targeted interventions to promote equitable access to guideline-recommended acute cardiac care.

## Introduction

Non-ST elevation myocardial infarction (NSTEMI) is a leading cause of morbidity and mortality worldwide, necessitating timely and evidence-based management strategies. Percutaneous coronary intervention (PCI) is the cornerstone of invasive treatment, with current guidelines recommending early coronary angiography and revascularization, particularly in high-risk patients. The European Society of Cardiology (ESC) and the American College of Cardiology (ACC) suggest that NSTEMI patients with a

high Global Registry of Acute Coronary Events (GRACE) score (> 140) should undergo coronary angiography within 24 hours of admission, as early intervention has been associated with improved outcomes, including reduced mortality and lower rates of recurrent ischemic events (1,2). Despite these recommendations, disparities in the promptness of PCI exist, driven by sociodemographic factors such as race, gender, socioeconomic status, and insurance type (3–5).

A growing body of literature has highlighted inequities in cardiovascular care, particularly in the management of acute coronary syndromes (ACS). Women, racial minorities, and lower-income populations have consistently been shown to experience delays in receiving evidence-based therapies, including delayed or decreased rates of PCI (6–8). Structural and systemic barriers, including implicit bias in clinical decision-making, disparities in healthcare access, and differences in symptom presentation, contribute to these inequities. Previous studies have demonstrated that women with NSTEMI are less likely to undergo invasive management than men, despite similar or greater disease severity (9). Similarly, Black, Hispanic, and Native American patients have been reported to have lower rates of early PCI compared to White patients. This gap persists even after adjusting for clinical risk factors and comorbidities (10). Beyond racial and gender disparities, socioeconomic status plays a pivotal role in healthcare access and quality. Patients from lower-income backgrounds often encounter financial barriers, reduced access to high-resource medical centers, and a higher burden of comorbid conditions, all of which contribute to lower rates of early PCI (11).

Despite widespread acknowledgment of these disparities, there remains a gap in systematically quantifying the magnitude and impact of sociodemographic factors on early PCI rates among NSTEMI patients. This study aims to analyze the influence of race, gender, socioeconomic status, and insurance coverage on the likelihood of undergoing PCI within 24 hours of hospital admission using data from the National Inpatient Sample (NIS) 2021 database. By identifying and quantifying these disparities, we seek to provide evidence to support targeted policy interventions to promote equitable access to cardiovascular care and reduce disparities in acute cardiac treatment outcomes.

# Methods

This study utilized the National Inpatient Sample (NIS) 2021 database, a component of the Healthcare Cost and Utilization Project (HCUP) sponsored by the Agency for Healthcare Research and Quality (AHRQ). The NIS is the largest publicly available all-payer inpatient healthcare database in the United States and provides nationally representative estimates of hospitalizations. Due to the de-identified nature of the data, Institutional Review Board (IRB) approval was not required for this study.

This cross-sectional study included adult patients (≥ 18 years) with a principal diagnosis of non-ST elevation myocardial infarction (NSTEMI), identified using the International Classification of Diseases, Tenth Revision, and Clinical Modification (ICD-10-CM) codes. Patients with missing data on primary variables were excluded. Sociodemographic Characteristics: Gender, race/ethnicity, inferred median household income quartiles (ZIP Code-linked), and insurance type. Comorbidities were summarized

using the Elixhauser Comorbidity Index, and disease severity was classified using All Patient Refined Diagnosis-Related Groups (APR-DRG) severity and mortality risk scores. The primary outcome was the performance of percutaneous coronary intervention (PCI) within 24 hours of admission.

All analyses were conducted using STATA/BE 18.0. Logistic regression models evaluated the association between sociodemographic factors and the primary outcome. Models were adjusted for hospital size, comorbidity burden, and severity of presentation (APR-DRG metrics). Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). Statistical significance was defined as a two-tailed p-value < 0.05.

## Results

# Sociodemographic Characteristics of NSTEMI Admissions

As shown in Table 1, NSTEMI admissions were significantly higher in the lowest income quartile (127,660) compared to the highest (74,025). Patients in the lowest quartile were younger (66.54 ± 13.10 years vs. 69.12 ± 13.10 years, *p* < 0.001). NSTEMI admissions involving male patients constituted the majority of NSTEMI cases (61.16%), with a higher proportion in the highest income quartile (64.43%) than the lowest (58.77%). Conversely, NSTEMI admissions involving female patients were more prevalent in the lowest quartile (41.23%) than the highest (35.57%).

Hospital bed size distribution did not differ significantly across income quartiles (p = 0.1052). However, racial distribution varied significantly (*p* < 0.001). Caucasians accounted for the largest proportion of admissions in the lowest (64.90%) and highest (74.07%) income quartiles. Black/African American (19.65% vs. 6.57%) and Hispanic (11.57% vs. 6.62%) admissions were disproportionately higher in the lowest income quartile.

Insurance status differed significantly across income groups (*p* < 0.001). Medicare was the most common payer (~ 59%) in all quartiles. Medicaid enrollment was higher in the lowest income quartile (12.84% vs. 6.63%), whereas private insurance was more common in the highest (29.45% vs. 19.35%). Self-pay and no-charge patients were more frequent in the lowest income quartile.

Smoking prevalence was significantly higher in the lowest quartile (49.19% vs. 40.03%, *p* < 0.001). Hypertension, diabetes, and heart failure were also more common in this group, with heart failure affecting 42.99% of patients in the lowest income quartile compared to 35.89% in the highest (*p* < 0.001). Atrial fibrillation was more prevalent in the highest income quartile (22.74% vs. 20.67%, *p* < 0.001). CKD and ischemic stroke rates did not differ significantly between quartiles (*p* = 0.0683 and *p* = 0.5294, respectively).

## Income, Gender, Race, and Insurance Disparities in Early PCI Utilization

Early PCI rates varied significantly by income and gender (Table 2a). Admissions involving patients in the highest income quartile had higher early PCI rates (21.64%) than those in the lowest quartile (18.49%) ($p < 0.001$). Patients in the highest quartile had 22% greater odds of receiving early PCI (OR: 1.22). Gender differences were also significant, with admissions involving males more likely to receive early PCI (21.96%) than females (16.91%) ($p < 0.001$).

Racial disparities were evident (Table 2b, $p < 0.001$). Admissions involving Caucasians had the highest early PCI rates (21.03%), whereas Black/African Americans (16.38%) and Native Americans (15.34%) had the lowest. Hispanics (17.14%) and Asian/Pacific Islanders (17.45%) had intermediate rates.

Early PCI rates also varied by insurance type (Table 2c, $p < 0.001$). Admissions involving patients with private insurance had the highest rates (26.28%), followed by self-pay patients (25.05%). In contrast, Medicaid (19.73%) and Medicare (17.08%) patients had lower rates, highlighting disparities in access to early PCI.

## Predictors of Early PCI: Socioeconomic, Demographic, and Clinical Factors

The multivariate analysis (Table 3) identified significant predictors of early PCI. Median household income by ZIP code demonstrated a gradient effect. Compared to Quartile 1, Quartile 2 showed no significant difference (OR: 1.02, 95% CI: 0.97–1.08, $p = 0.472$), while Quartile 3 (OR: 1.09, 95% CI: 1.03–1.16, $p = 0.002$) and Quartile 4 (OR: 1.10, 95% CI: 1.03–1.17, $p = 0.003$) were associated with higher odds. Hospital bed size was positively associated with early PCI. Compared to small hospitals, medium-sized hospitals had higher odds (OR: 1.12, 95% CI: 1.04–1.22, $p = 0.005$), as did large hospitals (OR: 1.14, 95% CI: 1.06–1.24, $p = 0.001$). Race and ethnicity disparities were evident. Compared to Caucasian individuals, Black/African Americans (OR: 0.895, 95% CI: 0.835–0.960, $p = 0.002$), Hispanics (OR: 0.819, 95% CI: 0.760–0.881, $p < 0.001$), Asian/Pacific Islanders (OR: 0.793, 95% CI: 0.710–0.890, $p < 0.001$), and Native Americans (OR: 0.674, 95% CI: 0.499–0.909, $p = 0.010$) had lower odds of receiving early PCI. Age was not a significant predictor (OR: 0.999, 95% CI: 0.997–1.001, $p = 0.392$), while female patients had lower odds (OR: 0.914, 95% CI: 0.874–0.955, $p < 0.001$). Insurance type was not significantly associated with early PCI. Comorbidities and risk severity were inversely associated with early PCI. Higher Elixhauser Comorbidity Index (OR: 0.959, 95% CI: 0.947–0.972, $p < 0.001$), APRDRG score (OR: 0.937, 95% CI: 0.929–0.945, $p < 0.001$), APRDRG Risk of Mortality score (OR: 0.482, 95% CI: 0.462–0.502, $p < 0.001$), and APRDRG Severity score (OR: 0.911, 95% CI: 0.871–0.950, $p < 0.001$) were all associated with lower odds of early PCI.

## Discussion

Gender and socioeconomic status were significant determinants of early PCI rates, with males having higher odds of receiving timely intervention compared to females. Socioeconomic disparities were evident, as individuals in higher income quartiles had greater access to early PCI than those in lower-

income groups. Patients with private insurance and self-pay individuals had significantly higher odds of undergoing early PCI than those with public insurance. Racial disparities were also observed, with Black, Hispanic, Asian, and Native American populations less likely to receive early PCI compared to White patients.

Our study found that men are significantly more likely to receive timely intervention, with 38% higher odds of undergoing early PCI compared to women. While consistent with prior research, this disparity highlights ongoing inequities in acute cardiac care. In a study involving approximately 200,000 patients, men were reported to have worse baseline characteristics, such as higher rates of comorbidities and greater disease severity, yet, women were more likely to present with NSTEMI, which may contribute to differences in care pathways (12).

Additionally, women often present with atypical symptoms, including fatigue, nausea, or back pain, rather than classic chest pain, which can delay recognition and intervention (6,13). These delays, combined with implicit biases in clinical decision-making, result in women being less likely to receive guideline-directed therapies, including PCI, even when presenting with similar or lower-risk profiles compared to men (13,14). However, several studies have shown that women exhibit higher rates of STEMI and NSETMI-related in-hospital and short-term mortality (15,16). The findings of our study emphasize the need for gender-sensitive diagnostic protocols and targeted educational initiatives to address disparities in symptom recognition and treatment pathways for women with acute coronary syndromes.

In our study, minority racial groups, including blacks, Hispanics, Asians or Pacific Islanders, and Native Americans, were less likely to undergo timely PCI for NSTEMI in comparison to their white peers ($p < 0.001$). Similar findings were documented in the literature regarding blacks and Hispanics > 65 years of age having a longer door-to-balloon time and lower rates of PCI utilization (17). In addition, these two groups were reported to have decreased coronary artery bypass grafting rates and higher 30-day readmission risk (18). In a study that was designed to follow the trend of revascularization therapy for 15 years, no significant improvement in racial and ethnic differences in the utilization of diagnostic coronary angiograms or PCI in patients with NSTEMI or STEMI were noted (19).

Historically, it has been reported that African American women are at increased risk of CVD (20) and that they are more likely to present with AMI, suggesting delayed diagnosis and suboptimal preventive care (21). Interestingly, it was reported that black women have 2.4 fold increased risk of CVD, but the CARDIA study (Coronary Artery Risk Development in Young Adults; N = 5112) with a median follow-up of > 33 years identified that premature CVD risk in Black participants was attenuated after adjustment for lifestyle, neighborhood, and socioeconomic factors (22,23).

Efforts to address the inequities embedded in the U.S. healthcare system have included landmark reforms such as the Affordable Care Act (ACA), which expanded Medicaid and aimed to mitigate racial and ethnic disparities in access to care. The ACA has indeed improved healthcare access for many underserved populations, mainly through increased insurance coverage and Medicaid expansion, facilitating access to timely interventions like PCI in states such as California and Florida (24,25).

However, these benefits have been neither universal nor sufficient to resolve systemic inequities fully. Safety-net hospitals and clinics, which disproportionately serve racial and ethnic minorities, remain underfunded and financially strained, limiting their capacity to deliver high-quality care (26).

Additionally, while the ACA has helped reduce disparities for major racial groups, its impact on smaller populations, such as Native and Asian Americans, remains unclear due to their underrepresentation in healthcare databases and studies (27,28). This lack of inclusion reflects the broader structural challenges in addressing health inequities, which are rooted in policies that advantage the White population while perpetuating barriers for minority communities (26). Thus, while progress has been made, these initiatives reveal the limitations of singular policy reforms and highlight the need for more targeted, sustained efforts to ensure equitable access across all populations.

This study has some limitations. The cross-sectional design prevents establishing causality between sociodemographic factors and early PCI rates, requiring further longitudinal research. Using administrative data from the National Inpatient Sample (NIS) may introduce misclassification bias, as ICD-10-CM codes may not capture all clinical factors influencing PCI decisions. While confounders like comorbidity and disease severity were adjusted, residual confounding is possible due to the lack of detailed clinical variables. The study may also be underpowered to detect disparities in smaller groups, such as Native Americans. Unmeasured factors like implicit bias and regional healthcare disparities may also contribute to observed inequities. Despite these limitations, the study provides valuable insights into sociodemographic disparities in early PCI rates and suggests areas for future research.

This study highlights sociodemographic disparities in access to early percutaneous coronary interventions (PCI) for NSTEMI patients. Men, individuals with higher incomes, and those with private insurance or self-pay were more likely to receive timely PCI. Racial disparities were also evident, with Black, Hispanic, Asian, and Native American patients less likely to undergo early PCI compared to White patients. These findings underscore the need to address gaps in cardiovascular care, particularly for women and minorities. Policy changes are essential, including strengthening safety-net hospitals and reducing implicit bias in clinical decision-making. Further research is needed to assess the impact of sociodemographic factors and healthcare policies on cardiovascular outcomes.

Table 1
CHARACTERISTICS OF THE STUDY POPULATION

| VARIABLE | NSTEMI AND LOWEST INCOME QUARTILE | NSTEMI AND HIGHEST INCOME QUARTILE | TOTAL NSTEMI ADMISSIONS | P-VALUE |
|---|---|---|---|---|
| Total | 127660 | 74025 | 406795 | |
| Age mean +-SD (years) | 66.54(13.10) | 69.12(13.10) | 67.77(13.08) | < 0.001 |
| Gender | | | | < 0.001 |
| Female | 41.23 | 35.57 | 38.84 | |
| Male | 58.77 | 64.43 | 61.16 | |
| Hospital Bed size | | | | 0.1052 |
| Small | 19.41 | 22.18 | 21.22 | |
| Medium | 29.77 | 31.23 | 29.85 | |
| Large | 50.81 | 46.59 | 48.93 | |
| Race | | | | < 0.001 |
| Caucasian | 64.90 | 74.07 | 71.92 | |
| Black/ African American | 19.65 | 6.57 | 11.89 | |
| Hispanic | 11.571 | 6.62 | 9.57 | |
| Asian or Pacific Islander | 01.03 | 7.79 | 3.19 | |
| Native American | 00.95 | 0.33 | 0.64 | |
| Others | 01.90 | 4.61 | 2.79 | |
| Insurance Type | | | | < 0.001 |
| Medicare | 58.17 | 59.16 | 58.94 | |
| Medicaid | 12.84 | 6.63 | 9.90 | |
| Private Insurance | 19.35 | 29.45 | 23.61 | |
| Self-pay | 5.54 | 2.24 | 3.94 | |
| No charge | 0.41 | 0.28 | 0.36 | |
| Other | 3.69 | 2.24 | 3.25 | |

| VARIABLE | NSTEMI AND LOWEST INCOME QUARTILE | NSTEMI AND HIGHEST INCOME QUARTILE | TOTAL NSTEMI ADMISSIONS | P-VALUE |
|---|---|---|---|---|
| Smoking Status | 49.19 | 40.03 | 45.87 | < 0.001 |
| Comorbidities | | | | |
| Hypertension | 36.37 | 39.59 | 37.89 | < 0.001 |
| Diabetes | 47.19 | 39.76 | 44.26 | < 0.001 |
| CKD | 27.62 | 26.63 | 27.36 | 0.0683 |
| Heart Failure | 42.997 | 35.89 | 39.92 | < 0.001 |
| Atrial Fibrillation | 20.67 | 22.74 | 21.63 | < 0.001 |
| Ischemic Stroke | 1.14 | 1.20 | 1.15 | 0.5294 |

Table 2
a: CLINICAL OUTCOME MEASURES BY INCOME AND GENDER

| Outcome Incidence | NSTEMI and LOWEST INCOME QUARTILE<br><br>ZIPINC_QRTL = 1 | NSTEMI and HIGHEST INCOME QUARTILE<br><br>ZIPINC_QRTL = 4 | ODDS RATIO OR DIFFERENCE | p-VALUE |
|---|---|---|---|---|
| Early PCI rates | 18.49 | 21.64 | 1.22 | < 0.001 |
| Outcome Incidence | NSTEMI and FEMALE | NSTEMI and MALE | ODDS RATIO OR DIFFERENCE | p-VALUE |
| Early PCI rates | 16.91 | 21.96 | 1.38 | < 0.001 |

Table 2
b. CLINICAL OUTCOME MEASURES BY RACE

| Outcome Incidence | Caucasian | Black/African American | Hispanic | Asian/Pacific Islander | Native American | p-Value |
|---|---|---|---|---|---|---|
| Early PCI rates | 21.03 | 16.38 | 17.14 | 17.45 | 15.34 | < 0.001 |

Table 2
c. CLINICAL OUTCOME MEASURES BY INSURANCE TYPE

| Outcome Incidence | Medicare | Medicaid | Private Insurance | Self-Pay | p-Value |
|---|---|---|---|---|---|
| Early PCI rates | 17.08 | 19.73 | 26.28 | 25.05 | < 0.001 |

Table 3
MULTIVARIATE ANALYSIS OF PRIMARY OUTCOME

| VARIABLE | OR | 95 CI | p-VALUE |
|---|---|---|---|
| Median Household Income by ZIP Code (Income) | | | |
| Quartile 1 (Lowest) | Comparison group | | |
| Quartile 2 | 1.020362 | 0.97–1.08 | 0.472 |
| Quartile 3 | 1.09381 | 1.03–1.16 | 0.002 |
| Quartile 4 (Highest) | 1.101713 | 1.03–1.17 | 0.003 |
| Hospital Bed size | | | |
| Small | | | |
| Medium | 1.12 | 1.04–1.22 | 0.005 |
| Large | 1.14 | 1.06–1.24 | 0.001 |
| Race | | | |
| Caucasian | Comparison group | | |
| Black/African American | 0.895 | 0.835–0.9599 | 0.002 |
| Hispanic | 0.819 | 0.760–0.881 | < 0.001 |
| Asian/Pacific Islander | 0.793 | 0.71–0.89 | < 0.001 |
| Native American | 0.674 | 0.499–0.909 | 0.010 |
| Age | 0.999 | 0.997–1.001 | 0.392 |
| Female | 0.914 | 0.874–0.955 | < 0.001 |
| Insurance Type | | | |
| Medicare | Comparison group | | |
| Medicaid | 0.937 | 0.868–1.011 | 0.095 |
| Private Insurance | 0.968 | 0.909–1.030 | 0.304 |
| Self-Pay | 1.039 | 0.937- 1.153 | 0.463 |
| No charge | 0.955 | 0.693- 1.315 | 0.777 |
| Others | 0.980 | 0.876- 1.098 | 0.731 |
| Elixhauser Comorbidity Index | 0.959 | 0.947- 0.972 | < 0.001 |
| APRDRG | 0.937 | 0.929–0.945 | < 0.001 |
| APRDRG_Risk_Mortality | 0.482 | 0.462–0.502 | < 0.001 |

| VARIABLE | OR | 95 CI | p-VALUE |
|---|---|---|---|
| APRDRG_Severity | 0.911 | 0.871–0.950 | < 0.001 |

# Glossary

- **Early PCI:** Percutaneous coronary intervention performed within 24 hours of hospital admission for high-risk NSTEMI patients, as recommended by clinical guidelines.

- **National Inpatient Sample (NIS):** The largest publicly available all-payer inpatient healthcare database in the U.S., used for research on hospital utilization and patient outcomes.

- **Elixhauser Comorbidity Index:** A scoring system that accounts for the presence of multiple chronic conditions to predict healthcare outcomes and resource utilization.

- **All Patient Refined Diagnosis-Related Groups (APR-DRG):** A classification system that adjusts for severity of illness and risk of mortality in hospitalized patients.

# Declarations

Funding Statement:

This study was conducted without financial support or external funding from any organization, institution, or funding agency.

Data Availability Statement:

The datasets used in this study are publicly available through the National Inpatient Sample (NIS) within the Healthcare Cost and Utilization Project (HCUP) database.

Conflict of Interest Disclosure:

The authors declare that they have no financial, personal, or professional conflicts that could influence the results or interpretation of this study.

Ethics Approval Statement:

This study uses publicly available, de-identified data from the NIS database. As such, no ethical approval was required, as the study does not involve direct interaction with participants or collection of personal data.

Author Contributions

K.O. and H.E.N. contributed to Conceptualization, Formal analysis, Data curation, Investigation, Methodology, Software, Validation, Visualization, and Writing – original draft. B.A. contributed to

Methodology, Project administration, Validation, Visualization, and Writing – original draft. T.A. contributed to Supervision, Project administration, Validation, Visualization, and Writing – original draft. K.O. and H.E.N. performed Writing – review & editing. L.M.E.A.O., A.A., M.F., K.S.P., O.O.F., V.E.O., A.H., D.F.U., B.A., and T.A. contributed to Writing – review & editing and Writing – original draft. All authors reviewed and approved the final manuscript.

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