Population Trends in Rates of Percutaneous Coronary Revascularization

for Acute Coronary Syndromes Associated with the COVID-19 Outbreak

Running Title: *Piccolo et al.; PCI Rates for ACS During the COVID-19 Pandemic*

Raffaele Piccolo, et al.

The full author list is available on page 5.

Address for Correspondence:
Giovanni Esposito, MD, PhD
Division of Cardiology
Department of Advanced Biomedical Sciences
UNESCO Chair on Health Education and Sustainable Development
University of Naples Federico II
Via S. Pansini, 5. 80131, Naples, Italy
Tel/Fax: +39 081 746 3075
Email: espogiov@unina.it

Data sharing: The data that support the findings of this study are available from the corresponding author upon reasonable request.

A reduction in hospital admissions for acute coronary syndromes (ACS) has been observed globally in the aftermath of the pneumonia outbreak caused by coronavirus disease 2019 (COVID-19).[1] Despite emergence of anecdotal reports, formal evaluation of variation in percutaneous coronary intervention (PCI) rates during the COVID-19 outbreak has not yet been reported. Italy is one of the countries most heavily affected by the COVID-19 pandemic with 168,941 confirmed cases and 22,170 deaths as of April 5, 2020.

We investigated the association between the outbreak of COVID-19 and PCI rates for ACS in the Campania region, which with 5.8 million residents represents about 10% of the Italian population. Data were obtained from 20 out of 21 PCI centers over an 8-week period, including 4-week before and 4-week after the COVID-19 outbreak corresponding with the first reported case declared by the Civil Protection Department on February 27, 2020. Incidence rates and their ratios were calculated using Poisson regression analysis and interactions for gender and age were estimated by adding the interaction term to the regression models.[2] Population denominators, which were used as offset, were obtained from the Italian census. The ratio change in PCI rates for the entire 8-week interval was estimated by adding a linear term to the Poisson regression. The study was approved by the Ethics Committee of the University of Naples Federico II (Naples, Italy).

From January 30, 2020 to March 26, 2020, a total of 1,831 PCIs were performed in the Campania region; of them 738 (40.31%) were elective PCI (not included), 604 (32.99%) PCI for non-ST-segment elevation acute ACS (NSTE-ACS), and 489 (26.71%) PCI for ST-segment elevation myocardial infarction (STEMI). Mean age was 65.7 years (standard deviation 12), and 804/1,093 PCIs (73.56%) were performed in men. There were no differences in mean age

(65.8±11.8 vs. 65.6±12.2 years, P=0.78) and proportion of men (72% vs. 75%, P=0.29) in the 4-week before the COVID-19 outbreak compared to the subsequent 4-week.

The incidence rate of PCI for ACS decreased from 178 to 120 cases/100,000 residents per-year during the 4-week period before compared with after the COVID-19 outbreak (**Figure 1**). The incidence rate ratio (IRR) was 0.68. The reduction was similar for both NSTE-ACS and STEMI (from 98 to 66 and from 80 to 54 PCI cases/100,000 residents per-year, respectively). The decrease in PCI for ACS was more evident in women (IRR 0.60) than in men (IRR 0.70), resulting in a significant interaction (P<0.001). There was heterogeneity (P-interaction <0.001) in the decline of PCI rates across age categories, with patients <55 years of age less affected by the reduction (IRR 0.75). Findings were consistent between PCI centers in the metropolitan (IRR 0.72) vs. non-metropolitan area (IRR 0.62). Over the interval from week -4 to week +4, the ratio change in PCI rate was 0.51 (95%CI, 0.50-0.52) for ACS, 0.54 (95%CI, 0.53-0.56) for NSTE-ACS, and 0.47 (95%CI 0.45-0.49) for STEMI (**Figure 1**). Compared with the same period in 2019, PCI rates decreased from 190 to 120, from 107 to 66, and from 84 to 54 cases/100,000 residents per-year for ACS (IRR 0.63), NSTE-ACS (IRR 0.62), and STEMI (IRR 0.64), respectively.

In the third most populous region of Italy, we found evidence that the outbreak of COVID-19 was associated with a decline by 32% in the number of PCI for ACS. In the last 2 weeks of the observational period, PCIs for ACS were reduced by 50%. When compared with PCI volumes for the same time in 2019, the decline in PCI rates was of similar magnitude (between 36-38%).

Mechanisms underpinning this decrease are unknown, although several explanations might be involved. Chest pain might be underestimated or misestimated by patients due to the

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fear of exposure to COVID-19-affected subjects at hospital admission. This hypothesis might be supported by the stronger decline in PCI rates among women, in whom misdiagnosis and delayed revascularization are more likely to occur in an ACS setting.[3] Other explanations might be related to the unique situation of a country lockdown, potentially leading to less physical activity that might trigger an ACS, coupled with reduced air pollution.

Our data indicate that the COVID-19 outbreak was associated with a remarkable decrease in the rates of PCI across the entire spectrum of ACS. Although we did not measure the hospitalization rates for ACS, PCI represents the most common revascularization modality for ACS patients. The Campania region has been less affected than others by the COVID-19 pandemic and, as a result, no changes occurred during the study period in the regional hub-and-spoke care system and in the management of ACS patients. Therefore, PCI rates effectively reflect ACS rates. However, we cannot determine to what extent the observed trends reflect changes in patient or physician behavior vs. incident ACS.

The findings of this study might have important implications for healthcare systems and suggest that public campaigns aiming to increase awareness of ischemic symptoms should be reinforced during the COVID-19 pandemic. The lack of appropriate and timely revascularization for ACS patients might have other important clinical consequences, not yet measured, including increased risk for heart failure or sudden cardiac death.

Disclosures

None

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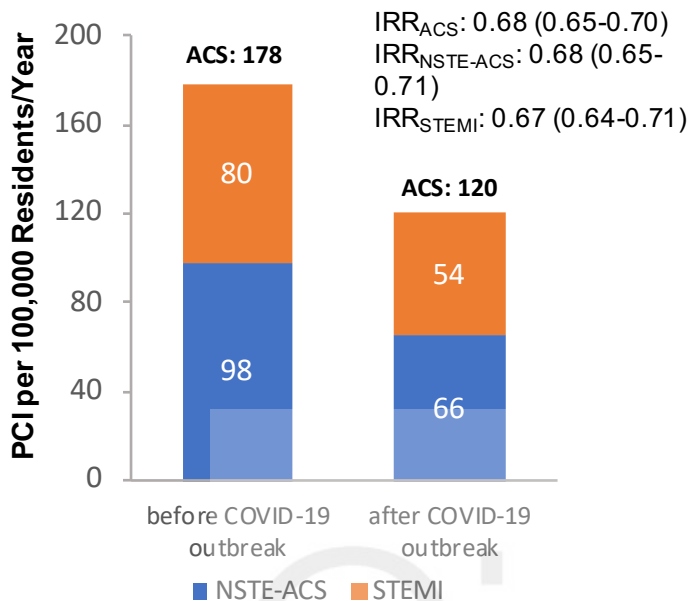
Authors

Raffaele Piccolo, MD, PhD[1]; Dario Bruzzese, MD, PhD[2]; Ciro Mauro, MD[3];

Antonio Aloia, MD[4]; Cesare Baldi, MD[5]; Marco Boccalatte, MD[6]; Giuseppe Bottiglieri, MD[7];

Carlo Briguori, MD[8]; Gianluca Caiazzo, MD, PhD[9]; Paolo Calabrò, MD, PhD[10];

Maurizio Cappelli-Bigazzi, MD[11]; Ciro De Simone, MD[12]; Emilio Di Lorenzo, MD[13];

Paolo Golino, MD, PhD[11]; Vittorio Monda, MD[14]; Rocco Perrotta, MD[15];

Gaetano Quaranta, MD[16]; Enrico Russolillo, MD[17]; Marino Scherillo, MD[18];

Tullio Tesorio, MD[19]; Bernardino Tuccillo, MD[20]; Giuseppe Valva, MD[21]; Bruno Villari, MD[22];

Giuseppe Tarantini, MD, PhD[23]; Attilio Varricchio, MD[24]; Giovanni Esposito, MD, PhD[1,25]

[1]Division of Cardiology, Department of Advanced Biomedical Sciences, University of Naples Federico II, Naples, Italy; [2]Department of Public Health, University of Naples Federico II, Naples, Italy; [3]Interventional Cardiology and Cardiological Care Unit, A.O.R.N. Cardarelli, Naples, Italy; [4]Division of Cardiology, Presidio Ospedaliero di Vallo della Lucania, Italy; [5]Interventional Cardiology Unit. A.O.U. San Giovanni di Dio e Ruggi d'Aragona, Salerno, Italy; [6]Division of Cardiology, Ospedale Santa Maria delle Grazie, Pozzuoli, Italy; [7]Division of Cardiology, Presidio Ospedaliero di Eboli, Italy; [8]Mediterranea Cardiocentro, Naples, Italy; [9]Division of Cardiology, Ospedale San Giuseppe Moscati, Aversa, Italy; [10]Division of Cardiology, Department of Translational Medical Sciences, University of Campania "Luigi Vanvitelli", Naples, Italy; [11]Division of Cardiology, Luigi Vanvitelli University, Monaldi Hospital, Naples, Italy; [12]Villa dei Fiori Hospital, Acerra, Italy; [13]Division of Cardiology, Moscati Hospital, Avellino, Italy; [14]Division of Cardiology, AORN Ospedali dei Colli, Monaldi Hospital, Naples, Italy; [15]Division of Clinical Cardiology, A.O.R.N. Sant'Anna e San Sebastiano, Caserta, Italy; [16]Cardiology Unit, Umberto I Hospital, Nocera Inferiore, Italy; [17]Division of Cardiology, Ospedale San Giovanni Bosco, Naples, Italy; [18]Division of Cardiology. Rummo Hospital, Benevento, Italy; [19]Division of Invasive Cardiology, Clinica Montevergine, Mercogliano, Italy; [20]Department of Cardiology, Ospedale del Mare, Naples, Italy; [21]Department of Cardiology and Cardiac Surgery, Casa di Cura S. Michele, Maddaloni, Italy; [22]Ospedale Sacro Cuore di Gesù, Benevento, Italy; [23]Department of Cardiac, Thoracic, Vascular Sciences, University of Padua, Padua, Italy; [24]Division of Cardiology, Ospedale di Nola, Italy; [25]UNESCO Chair on Health Education and Sustainable Development.
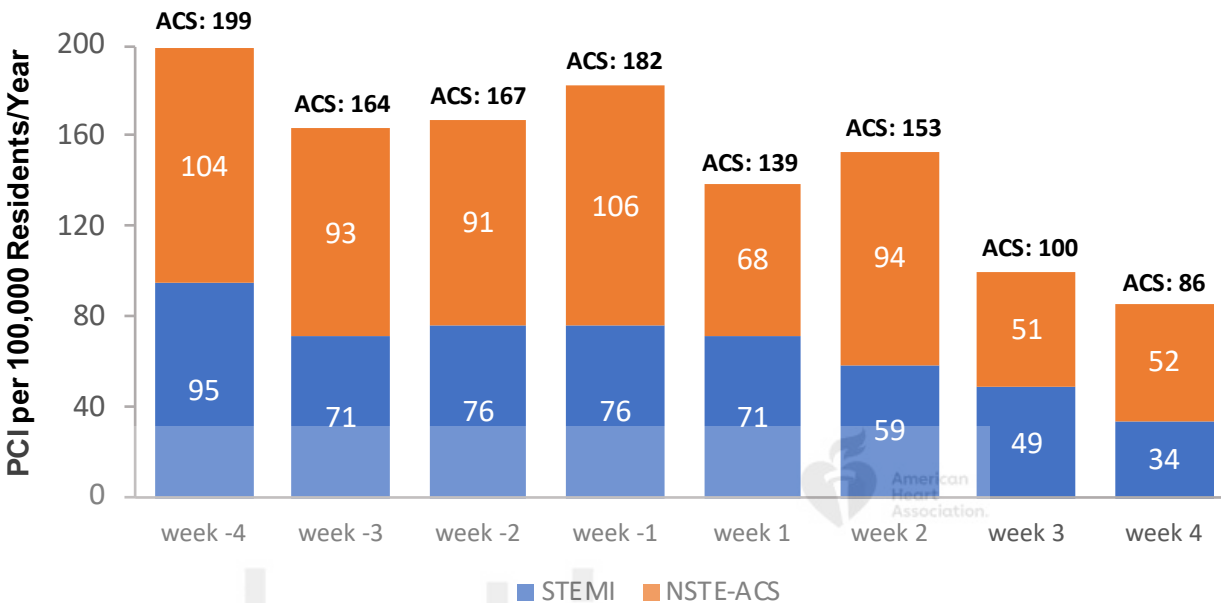
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Figure Legend

Figure 1. Panel A. Incidence rates before and after the first reported case of COVID-19 according to the type of ACS. Absolute numbers of PCI cases for ACS, NSTE-ACS, and STEMI were 652, 360, 292 and 441, 244, 197 in the 4-week before and after the outbreak of COVID-19, respectively. In 2019, PCI volumes for the corresponding 4-week period after the outbreak of COVID-19 were 699, 392, 307 for ACS, NSTE-ACS, and STEMI, respectively. **Panel B**. Incident rates by week according to the type of ACS. Weeks -4 to -1 represent the 4-week period before the first case of COVID-19 in the Campania region (Feb 27, 2020) and weeks 1 to 4 represent the 4-week perdiod after COVID-19 outbreak (data were collected until March 26, 2020). **Panel C**. Incidence rates of PCI for ACS before and after COVID-19 outbreak according to gender. **Panel D**. Incidence rates of PCI for ACS before and after COVID-19 outbreak according to age categories. ACS: acute coronary syndrome. IRR: incidence rate ratio. NSTE-ACS: non-ST-segment elevation ACS. PCI: percutaneous coronary intervention. STEMI: ST-segment elevation myocardial infarction.
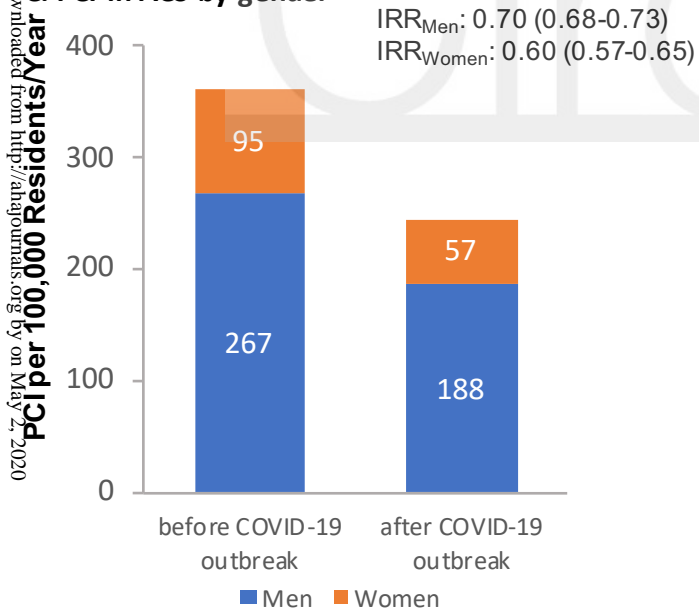
A. Type of ACS before and after COVID-19 outbreak

PCI per 100,000 Residents/Year

IRR$_{ACS}$: 0.68 (0.65-0.70)
IRR$_{NSTE-ACS}$: 0.68 (0.65-0.71)
IRR$_{STEMI}$: 0.67 (0.64-0.71)

ACS: 178 (NSTE-ACS 98, STEMI 80) — before COVID-19 outbreak
ACS: 120 (NSTE-ACS 66, STEMI 54) — after COVID-19 outbreak

Legend: NSTE-ACS, STEMI

B. Type of ACS during 8-week observational period

PCI per 100,000 Residents/Year

week -4: ACS: 199 (STEMI 95, NSTE-ACS 104)
week -3: ACS: 164 (STEMI 71, NSTE-ACS 93)
week -2: ACS: 167 (STEMI 76, NSTE-ACS 91)
week -1: ACS: 182 (STEMI 76, NSTE-ACS 106)
week 1: ACS: 139 (STEMI 71, NSTE-ACS 68)
week 2: ACS: 153 (STEMI 59, NSTE-ACS 94)
week 3: ACS: 100 (STEMI 49, NSTE-ACS 51)
week 4: ACS: 86 (STEMI 34, NSTE-ACS 52)

Legend: STEMI, NSTE-ACS

C. PCI in ACS by gender

PCI per 100,000 Residents/Year

IRR$_{Men}$: 0.70 (0.68-0.73)
IRR$_{Women}$: 0.60 (0.57-0.65)

before COVID-19 outbreak: Men 267, Women 95
after COVID-19 outbreak: Men 188, Women 57

Legend: Men, Women

D. PCI in ACS by age

PCI per 100,000 Residents/Year

IRR$_{<55\ yrs}$: 0.75 (0.70-0.81)
IRR$_{55-64\ yrs}$: 0.63 (0.59-0.67)
IRR$_{65-75\ yrs}$: 0.68 (0.64-0.73)
IRR$_{>75\ yrs}$: 0.66 (0.62-0.71)

before COVID-19 outbreak: <55 years 52, 55-64 years 310, 65-75 years 421, >75 years 289
after COVID-19 outbreak: <55 years 39, 55-64 years 196, 65-75 years 289, >75 years 274

Legend: <55 years, 55-64 years, 65-75 years, >75 years