Letter to the Editor

Acute myocardial infarction admissions among young adults in the United States: an update on the incidence and burden

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The most recent reports published by the American Heart Association have confirmed that cardiovascular disease (CVD) is the leading cause of death among Americans and 42.6% of deaths attributable to cardiovascular disease were related to coronary heart disease (CHD) [1]. Prior studies have shown that the incidence [2] and mortality rate [3] of acute myocardial infarction (AMI) among young adults have not improved over the last few decades in the United States. However, there are very limited updated data on the most recent impact of AMI in that particular age group. We therefore queried data from the 2017 National (Nationwide) Inpatient Sample (NIS) database to provide an updated assessment of the burden of AMI in the United States among young adults.

The 2017 NIS is the largest inpatient hospital database in the United States and was produced by the Healthcare Cost and Utilization Project (HCUP). The NIS is funded by the Agency for Healthcare Research and Quality and its partners [4]. The database is made up of all states that are covered by the HCUP and is estimated to include at least 97% of Americans. While it measures about 20% of all discharges, the weighting design allows users to provide a national estimate. Additional data about the NIS and HCUP can be found at https://www.hcup-us.ahrq.gov/nisoverview.jsp. As per HCUP DUA, our study is exempt from ethical approval.

We used SPSS 22.0 (IBM, Armonk, New York) for our analysis. Since the NIS data cover patients of all ages, we first converted the data into weighted form, then filtered patients to include only those of ages 30 to 54 inclusive. We proceeded to further categorize them into sub-groups of 30–34, 35–39, 40–44, 45–49, and 50–54 years of age [2]. The ICD-10 CM codes for AMI, provided by HCUP, were used to classify patients with a primary diagnosis of the disease. We also excluded patients who were transferred from another facility to avoid duplication of data and removed all patients who were discharged alive the same day and those with missing data for age, length of stay (LOS), sex, and in-hospital death/

alive status. Our selection criteria matched, as closely as we could, with the previous study conducted by Desai *et al.* for NIS data 2001–2010 [2]. However, the major difference was the change in coding from ICD-9 to ICD-10 which occurred in 2015. Chi-square tests helped evaluate any statistically significant differences in sex, race, age group, and primary expected payer. The LOS, total hospital charges, and mortality rates were also calculated. The presence of AMI in males and females per 100,000 persons in the United States was assessed using the 2017 US-census data (www.census.gov).

During the period of January 1st, 2017 to December 31st, 2017, the United States recorded an estimated 8,320,711 weighted admissions between the ages of 30 and 54. 92,725 (1.1%) patients presented with a primary diagnosis of acute myocardial infarction. The baseline characteristics of young adults with AMI recorded in our study are presented in Table I.

AMI was more common in young adult males than females (65,380 cases, 70.5%, 124.8 cases per 100,000 persons in males and 27,345 cases, 29.5%, 51.7 cases per 100,000 persons in females, $p < 0.01$). Racial differences were also found, as 62.4% of all AMI patients were White (56,125 cases, $p < 0.01$). The incidence of the condition increased with each age group (3% in 30–34, 7.7% in 35–39, 15.2% in 40–44, 29.4% in 45–49, 44.7% in 50–54 age group) and was highest in the oldest age group of 50–54 years old (41,405 cases, 44.7%, $p < 0.01$).

Table I. Acute myocardial infarction among young adults in the United States in 2017

Characteristics	Acute myocardial infarction admissions (%)	*P*-value
Sex, *n* (%):		< 0.01
Male	65380 (70.5)	
Female	27345 (29.5)	
Race, *n* (%):		< 0.01
White	56125 (62.4)	
Black	16055 (17.9)	
Age group, *n* (%):		< 0.01
30–34	2820 (3.0)	
35–39	7100 (7.7)	
40–44	14095 (15.2)	
45–49	27305 (29.4)	
50–54	41405 (44.7)	
Primary expected payer *n* (%):		< 0.01
Medicare	10735 (11.6)	
Medicaid	21830 (23.6)	
Private	43970 (47.5)	

The mean and total hospital charges of AMI were estimated at $91,406.14 and $8,429,930,707 respectively. Private insurance covered 47.5% of all AMI cases ($p < 0.01$), while Medicaid and Medicare covered 23.6% and 11.6% each respectively. The mean overall LOS was 3.49 days (3.48 days in males and 3.49 days in females). Unfortunately, 1345 patients with AMI died during their hospitalization and the mortality rate was 1.5% in 2017. 925 deaths were found among males (mortality rate of 1.4%), while 420 deaths were recorded among females (mortality rate of 1.5%).

This retrospective study of the 2017 NIS database offers a fresh update on the impact of AMI in young adults in the United States compared to previous reports published among similar population groups [2]. The overall AMI related hospitalization rates in males and females both decreased from 171 and 61 cases per 100,000 persons in 2010 to 124.8 and 51.7 cases per 100,000 persons in 2017 respectively [2]. Major improvements in sensitization campaigns to improve awareness as well as better compliance and treatment of several risk factors may be among the major reasons contributing to this positive change in incidence rate. Reynolds *et al.* also reported that there has been an increase in the use of several cardioprotective drugs in outpatient settings over the years that may have helped prevent episodes of AMI and lower their severity [5].

Our study further showed that the mortality rate in men and women admitted with a primary diagnosis of AMI has also improved as it decreased from 1.8 and 2.3 in 2010 to 1.5 and 1.4 in 2017 each. Improvements in hospital care, prompt management and changes in protocols for AMI patients could be among the driving forces for the improvement seen in our study [6]. We also observed that the LOS shortened from 3.8 and 4.0 days in 2010 to 3.48 and 3.49 days in males and females respectively in 2017 [2]. Previous studies have hypothesized that longer lengths of stays in patients with AMI may be linked with a higher risk of mortality, and the improvement in mortality rates in 2017 may explain the shorter LOS [7]. However, further research should be encouraged to fully understand this drop in LOS as HCUP data do not allow us to compare the severity of AMI cases registered [2]. A slightly higher mortality rate was observed in females (1.5%) than males (1.4%) in our study. In their analysis for adults of all age groups, Marrugat *et al.* also reported a higher mortality rate among women than men. They found that women were also more likely to be readmitted after 6 months [8]. Some reports have suggested that women may be at a higher risk as they are more likely to be treated less ag-

gressively than male patients with similar AMI related findings [9, 10].

There are some limitations to our study. The NIS is an administrative database and we rely mostly on diagnostic codes rather than clinical data for interpretation of the database. In their previous study, Gupta *et al.* used the ICD-9 codes, and as of 2015, the HCUP has been releasing data using the ICD-10 codes [2]. Several possible minor conflicts might influence a direct comparison. However, the HCUP provides a large sample size and the analysis of the data provides us with the closest option to evaluate changes in incidence and mortality among young adults in the United States.

In conclusion, our retrospective study reviewed 92,725 young adults in the United States who were admitted with a primary diagnosis of AMI throughout the year 2017 and identified a drop in incidence per 100,000 Americans and mortality rates related to AMI as well as an improvement in the length of stay.

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Conflict of interest

The authors declare no conflict of interest.

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