The Ongoing Importance of Smoking as a Powerful Risk Factor for ST-Segment Elevation Myocardial Infarction in Young Patients

There has been a recent decline in the incidence of patients presenting with ST-segment elevation myocardial infarction (STEMI). Whereas smoking is historically one of the strongest risk factors associated with STEMI, there has also been a decline in the proportion of current smokers in the United States from 1998 to 2010. The overall reduction in both the incidence of STEMI and active smoking makes it unclear what role smoking continues to play as a risk factor for STEMI. Accordingly, we used data from the 44 hospitals participating in the Blue Cross Blue Shield of Michigan Cardiovascular Consortium (BMC2) to evaluate the ongoing importance of smoking as a risk factor for STEMI.

Methods | The details of BMC2, a registry that enrolls all patients undergoing percutaneous coronary intervention (PCI) at nonfederal hospitals in Michigan, have been previously described. Our population included all patients who underwent primary PCI for new-onset STEMI between January 2010 and March 2012. Patients with a history of myocardial infarction or revascularization were excluded. Age-specific smoking rates for the general population were estimated using smoking prevalence data from the 2010 National Health Interview survey sample adult data set.

Smoking status was defined per patient report, with active smokers including those who had smoked any time within the past 1 year prior to presentation or before answering the survey. Population estimates by age for the state of Michigan were obtained from the 2010 US census and used to estimate primary PCI incidence by age group.

Odds ratios (ORs) comparing smoking prevalence among patients with STEMI with the prevalence in the general population were estimated directly. Estimated ORs and PCI prevalence values were used to estimate the number of current smokers needed to quit in order to prevent 1 STEMI, as well as the number and proportion of STEMI patients expected to be prevented annually in Michigan at various assumed annual quit rates.

Results | During the study period, 6892 patients underwent primary PCI for STEMI. In these patients, the overall mean (SD) smoking rate was 46.43% (0.60%), compared with 20.53% (0.25%) in the general population (Table). Smoking rates among patients with STEMI were highest for those aged 18 to 34 years, at 78.02% (4.34%), compared with a smoking rate of 23.72% (0.48%) in that age stratum of the general population, with smoking rates notably decreasing with increasing age in the STEMI population. The overall OR for smoking in the STEMI population compared with the general population was 3.4 (95% CI, 3.3–3.4), with the highest OR seen in patients aged 18 to 34 years (OR, 11.4 [95% CI, 10.0–12.8]).

We estimated that if 10% of Michigan smokers were to quit, 109 STEMI patients would be prevented annually, a reduction of 3.95% in the total number of PCI procedures performed for patients with STEMI. These estimates increased to 544 (19.73%) and 815 (29.63%) STEMI patients prevented annually with 50% and 75% quit rates, respectively.

Discussion | The key finding of our study is that smoking is a major risk factor for patients undergoing primary PCI for STEMI in the state of Michigan. We not only demonstrated the ongoing contribution of smoking as a risk factor for STEMI but also estimated the primary preventive benefit of smoking cessation with respect to STEMI. Although smoking is an important risk factor for STEMI at all ages, it is especially relevant in younger age groups.

Cigarettes are the only legal consumer product that cause half their long-term users to die prematurely. Notably, our study estimates that a reduction in the smoking rate down to

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Table. Smoking Rate in Patients With STEMI and the General Population and Number Needed to Quit to Prevent 1 STEMI Annually, Stratified by Age

<table>
<thead>
<tr>
<th>Age, y</th>
<th>Smoking Rate in Patients With STEMI (Mean ± SD)</th>
<th>Estimated Smoking Rate in the General Population (Mean ± SD)</th>
<th>STEMI Cases, No.</th>
<th>Odds Ratio (95% CI)</th>
<th>No. Needed to Quit</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-34</td>
<td>78.02 (4.34)</td>
<td>23.72 (0.48)</td>
<td>91</td>
<td>11.4 (10.0–12.8)</td>
<td>17 817</td>
</tr>
<tr>
<td>35-39</td>
<td>71.68 (3.43)</td>
<td>22.23 (0.84)</td>
<td>173</td>
<td>8.9 (7.7–10.0)</td>
<td>2694</td>
</tr>
<tr>
<td>40-44</td>
<td>69.19 (2.32)</td>
<td>21.43 (0.84)</td>
<td>396</td>
<td>8.2 (7.3–9.2)</td>
<td>1306</td>
</tr>
<tr>
<td>45-49</td>
<td>66.53 (1.74)</td>
<td>23.98 (0.86)</td>
<td>735</td>
<td>6.3 (5.6–7.0)</td>
<td>945</td>
</tr>
<tr>
<td>50-54</td>
<td>64.75 (1.50)</td>
<td>26.67 (0.90)</td>
<td>1010</td>
<td>5.1 (4.5–5.6)</td>
<td>870</td>
</tr>
<tr>
<td>55-59</td>
<td>53.91 (1.49)</td>
<td>22.80 (0.90)</td>
<td>1124</td>
<td>4.0 (3.5–4.4)</td>
<td>794</td>
</tr>
<tr>
<td>60-64</td>
<td>43.97 (1.56)</td>
<td>19.62 (0.87)</td>
<td>1012</td>
<td>3.2 (2.8–3.6)</td>
<td>882</td>
</tr>
<tr>
<td>≥65</td>
<td>22.85 (0.87)</td>
<td>10.02 (0.41)</td>
<td>2351</td>
<td>2.7 (2.4–3.0)</td>
<td>930</td>
</tr>
<tr>
<td>Overall</td>
<td>46.43 (0.60)</td>
<td>20.53 (0.25)</td>
<td>6892</td>
<td>3.4 (3.3–3.4)</td>
<td>1452</td>
</tr>
</tbody>
</table>

Abbreviation: STEMI, ST-segment elevation myocardial infarction.
12%, an objective laid out by Healthy People 2020 (http://www .healthypeople.gov), would translate to more than 450 STE-MIs prevented per year in Michigan alone. Achievement of goals for smoking quit rates in the United States requires the efforts of physicians, as well as modification of external influences such as public tobacco bans, additional tax increases on cigarettes, and marketing campaigns. Importantly, community smoking bans have been shown to reduce acute myocardial infarction in both smokers and nonsmokers, suggesting that our analysis likely underestimates the benefit of smoking cessation in regard to primary prevention of STEMI.

The results of our study should be interpreted with certain caveats. Our study enrolled all patients treated with primary PCI but did not include those treated with fibrinolysis or those who did not undergo reperfusion therapy. We did not control for other known cardiac risk factors, which may alter the results of the study. However, the magnitude of the effect seen in this study suggests a strong relationship between smoking and risk of new-onset STEMI that is unlikely to be entirely negated by the presence of other risk factors.

Our study provides evidence that smoking remains a powerful risk factor contributing to new-onset STEMI. Aggressive efforts should be made to promote smoking cessation for primary prevention of major cardiovascular events, with a specific focus in younger age groups.

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Author Contributions: Dr Gurm had full access to all of the data in the study and takes responsibility for the integrity of the data and accuracy of that data analysis.

Study concept and design: All authors.

Acquisition of data: Gurm.

Analysis and interpretation of data: All authors.

Drafting of the manuscript: Larsen and Seth.

Critical revision of the manuscript for important intellectual content: Seth and Gurm.

Statistical analysis: Seth.

Obtained funding: Gurm.

Administrative, technical, and material support: Gurm.

Study supervision: Gurm.

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COMMENT & RESPONSE

Efficacy vs Effectiveness
To the Editor: The recently published study by Ma et al (Evaluation of Lifestyle Interventions to Treat Elevated Cardiometabolic Risk in Primary Care [E-LITE] trial) tested 2 versions of the Diabetes Prevention Program (DPP) in the primary care setting and showed that both coach-based and DVD-based versions were superior to usual care. The investigators described their study as a “primary care-based translational intervention trial” and that these interventions have now been “proven effective in a primary care setting.”

We contend that the E-LITE study is an efficacy trial that has once again confirmed that the DPP works. That it works when DVD-delivered is promising because this is less intensive than a coach-based intervention. However, the trial actually offers little insight into adapting these interventions in a real-world primary care setting with real patients with metabolic syndrome. Effectiveness studies are designed to determine whether interventions, already proven efficacious under ideal circumstances, are effective when delivered in real-world settings, by staff in those settings, and with broad, representative populations. The E-LITE trial did not employ primary care staff to implement the interventions but instead used staff hired by the research team. Even the DVD-based intervention required staff to send reminders and field questions from participants. They also recruited a highly selective population by using 31 inclusion and exclusion criteria and randomizing only 15% of those screened by telephone. It remains unclear to what extent this sample represents typical patients with metabolic syndrome. The