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**File: ■ Cocoa (*Theobroma cacao*)**  
**■ Acute Myocardial Infarction**  
**■ Cardiac Mortality**

**HC 090192-391**

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**RE: Chocolate Consumption Is Associated with Lower Cardiac Mortality after Acute Myocardial Infarction**

Janszky I, Mukamal KJ, Ljung R, Ahnve S, Ahlbom A, Hallqvist J. Chocolate consumption and mortality following a first acute myocardial infarction: the Stockholm Heart Epidemiology Program. *J Intern Med.* 2009;266:248-257.

The health benefits of chocolate have been of increased interest in recent years because it is a rich source of flavonoid antioxidants. The results of several short-term clinical trials have shown beneficial effects of cocoa (*Theobroma cacao*) on the cardiovascular system, including improved endothelial function, inhibition of platelet activation and low-density-lipoprotein oxidation, and decreased blood pressure. Limited evidence supports the possible long-term cardioprotective effects of chocolate. Population-based studies have shown that chocolate or cocoa consumption is associated with lower cardiovascular mortality in postmenopausal women and in elderly men with no cardiovascular disease. However, the long-term effects of chocolate consumption in patients with established coronary heart disease is largely unknown. Thus, the present study was conducted to investigate the long-term effects of chocolate consumption on all-cause mortality, cardiac mortality, and non-fatal outcomes—including recurrent acute myocardial infarction (AMI) and hospitalization for heart failure and stroke—in patients who survived a first AMI.

A total of 1169 male and female participants in the Stockholm Heart Epidemiology Program—a population-based case-control study of incident AMI—were followed to assess mortality and hospitalization over an 8-year period. The study population consisted of Swedish citizens aged 45-70 years with a history of non-fatal AMI that occurred between 1992 and 1994. Persons with diabetes were excluded. The participants were given a questionnaire a few days after AMI onset to ascertain the frequency and quantity of chocolate, coffee, alcohol, sweets, and dessert consumption over the previous 12 months. Chocolate consumption (50 g portions) was categorized as never, less than once per month, up to once per week, and twice or more per week. A health examination on 1051 of the patients was conducted 3 months after AMI onset, and consisted of blood pressure, height and weight measurements, and blood collection for the measurement of lipids, coagulation factors, inflammatory markers, glucose,

insulin, and insulin-like growth factor binding protein-1. Mortality and hospitalization rates were ascertained from national registries for 8 years after hospital discharge. Adjusted mean biomarker levels were examined relative to categories of chocolate consumption.

An inverse, dose-response relation was observed between chocolate consumption and cardiac mortality in age- and sex-adjusted models after other potential confounders were taken into consideration. Compared with participants who never ate chocolate, those who consumed chocolate less than once per month, up to once per week, and twice or more per week had age-gender adjusted hazard ratios of 0.69, 0.67, and 0.43 ( $P = 0.02$ ) and multivariable-adjusted hazard ratios of 0.73, 0.56, and 0.34 ( $P = 0.01$ ), respectively. Intake of sweets other than chocolate had no statistically significant relation to cardiac mortality or all-cause mortality. The risk associated with chocolate consumption and cardiac mortality was not attenuated by adjustment for hypertension and systolic blood pressure. Chocolate consumers tended to have slightly lower risks of hospitalization and nonfatal cardiovascular events than did nonconsumers of chocolate, although there was no "clear evidence" of an association. Participants who consumed chocolate less than once per month had a substantially lower risk of stroke after the first 4 years of follow-up than did participants who consumed no chocolate. Of all the potential mediators of the effects of chocolate evaluated, only insulin concentrations had a modestly inverse association with chocolate consumption.

The results indicate that long-term "usual chocolate consumption" had a strong inverse association with subsequent cardiac mortality, but had weaker associations with all-cause mortality and nonfatal cardiovascular events. Two components of chocolate are thought to be responsible for the beneficial effects of chocolate observed: stearic acid and flavonoid antioxidants. Stearic acid is thought to have blood pressure-lowering effects, and flavonoid antioxidants improve endothelial function, inhibit platelet activation, and inhibit the oxidation of low-density-lipoproteins by free radicals. About 90% of chocolate consumed in Sweden in the 1990s was milk chocolate with about 30% cocoa solids, whereas milk and dark chocolate in the US contain minimums of 10% and 15%, respectively. The authors conclude that chocolate consumption is strongly associated with lower cardiac mortality in patients without diabetes who have survived their first AMI; however, they suggest that "confirmation of this strong inverse relationship from other studies is needed."

—Brenda Milot, ELS

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