



The effect of revascularization procedures on myocardial infarction incidence rates and time trends: The MONICA-Brianza and CAMUNI MI registries in Northern Italy

Giovanni Veronesi MS^a, Marco M. Ferrario MD^{a,*}, Lloyd E. Chambless PhD^b, Andrea Borsani MD^c, Carla Fornari PhD^d, Giancarlo Cesana MD^d

^a Centro Ricerche EPIMED, Epidemiologia e Medicina Preventiva, Università degli studi dell'Insubria, Varese, Italy

^b Department of Biostatistics, University of North Carolina at Chapel Hill, Chapel Hill, NC

^c Azienda Sanitaria Locale di Varese, Varese, Italy

^d Dipartimento di Medicina Clinica e Preventiva, Università di Milano–Bicocca, Monza, Italy

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ABSTRACT

Purpose: Clinical guidelines recommend early reperfusion treatment in myocardial infarction (MI) patients to reduce the cardiac damage. Epidemiologic definitions of MI are often based on the evolution of the cardiac lesion. We aim to study the effect of treatment on the estimates of rates and 20-year time trends of MI.

Methods: A Multinational Monitoring of trends and determinants in Cardiovascular disease (MONICA) register was active between 1985 and 2004 to survey 35- to 64-year-old residents in Brianza, Northern Italy. To the well-established MONICA definite MI, we added the MONICA possible nonfatal MI receiving either myocardial revascularization or thrombolysis within 24 hours from onset. The average annual relative changes in incidence rate and 28-day case fatality percentage were estimated from log-linear models.

Results: In our population, characterized by a monotonic decrease in coronary heart disease (CHD) mortality rates, the incident rate for the standard MONICA definite MI decreased yearly by 3% in both gender groups. The addition of selected revascularizations halved the downward trends in incidence rate in men and women; conversely, the decline in 28-day case fatality became steeper.

Conclusions: From an epidemiologic perspective, the increasing proportion of acute events efficaciously treated with revascularization therapy affects the estimate and the interpretation of time trends in MI incidence and CHD mortality.

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Introduction

At the end of the 1990s the World Health Organization–Multinational Monitoring of trends and determinants in Cardiovascular disease (MONICA) project, a study including mainly European populations, demonstrated that two thirds of the observed decline in population-specific coronary heart disease (CHD) death rates could be attributed to a decrease in myocardial infarction (MI) attack rates related to favorable changes in major risk factors [1,2]. These overall trends were also observed in one of the two MONICA-investigated populations in Northern Italy, the Brianza area [3,4].

Thereafter, mixed results in time trends of MI incidence, attack rates and case fatality were observed in the United States [5–7] and in Europe [8–10]. In Italy, the decline in CHD mortality continued through the 1990s, although it was mainly attributed to a decrease in case fatality, particularly in less affluent social strata [11]. These findings [5–11] were obtained from population-based registries, which concurrently registered hospitalized events and out-of-hospital deaths, and assigned a diagnostic category on the basis of symptoms and signs, anamnestic information, cardiac enzymes, and evolution of the cardiac lesion.

Changes in diagnostic tools, disease severity, and treatment procedures may affect the estimate of the time trends of CHD rates. In the last decade, the replacement of traditional cardiac enzymes (creatinine kinase [CK] and CK-myocardial band) with troponin I and T as markers of myocardial tissue damage increased the sensitivity of the diagnosis of MI [12–14]. During the 2000s, percutaneous coronary interventions (PCIs) replaced the thrombolytic treatment as

* Corresponding author. Centro Ricerche EPIMED-Epidemiologia e Medicina Preventiva, Università degli studi dell'Insubria, Via O Rossi 9–Padiglione Rossi–II piano, 21100 Varese, Italy.

E-mail address: marco.ferrario@uninsubria.it (M.M. Ferrario).

preferred revascularization procedure [15–17], especially for ST-elevated MIs [18,19], for which a primary PCI within 90 minutes from symptoms onset is currently recommended [20]. Coronary angiography also increased considerably from around 30% in 1987 and 1988 to more than 60% in 2001 [21]. As a consequence of the use of early reperfusion strategies in ST-elevation MIs, it has been suggested that an increasing proportion of acute events might be “interrupted” by treatment before they can evolve into clinically significant cardiac damage. One community-based study reported a decreasing trend in Q-wave and increasing trend in non-Q-wave MI incidence between 1975 and 1997 [22].

A number of studies have considered the effect of troponin on the estimation of CHD time trends [9,12,23–25]. Trends in treatment procedures have been so far monitored in clinical settings [15–19], and less attention has been paid to how the rising proportion of treated acute events can affect the MI trend estimates from an epidemiologic perspective. We aim to assess the potential impact of revascularization procedures in the estimation of 20-year trend in MI incidence and case fatality rates, in the 35- to 64-year-old MONICA-Brianza population.

Materials and methods

Population characteristics

The study population is 35- to 64-year-old residents of Brianza, which is located between Milan and the Swiss border. The area, characterized by a high level of industrialization and urbanization, has one of the highest average incomes in Italy. This population was originally identified within the MONICA project because it provided a satisfactory number of annual CHD deaths in men [26].

The MONICA and cardiovascular Monitoring Unit in Northern Italy MI registers in Brianza

The MONICA MI register was set up in 1985, after a 3-month pilot study in 1984, and continued through the entire 10-year observation period, up to the end of 1994. The cardiovascular Monitoring Unit in Northern Italy (CAMUNI) continued the surveillance on the same population and adopting the same procedures, for the biennia 1997–1998 and 2003–2004 (four time points available for analysis).

The MONICA and CAMUNI registers identified suspected fatal and nonfatal coronary events from death certificates and hospital discharge records. Investigated codes are summarized in Table 1. Based on the recognized low positive predictive value (about 3%, [11]) for in-hospital events with hospital discharge diagnosis codes of ICD-IX 412–414, in the last biennium those codes were reviewed only if they were reported as the main discharge diagnosis. The relevant clinical information available for the suspected hospitalized events was collected and reviewed to validate the event

according to the MONICA diagnostic algorithm [26] on the basis of symptoms at onset, maximum levels of cardiac enzymes (CK, CK-myocardial band, and lactate dehydrogenase) at hospital arrival, and a sequence of up to four electrocardiograms (coded according to the Minnesota criteria) that describes the evolution of the cardiac lesion. A positive history of MI was defined on the basis of anamnestic information or documented evidence of a previous acute event in the clinical record. Out-of-hospital deaths were investigated through interview of a relative or of the decedent’s general practitioner; necropsy findings and previous history of CHD contributed to the validation process. The validation algorithm did not change over time; specifically, although troponin was introduced in study-area hospitals in 2003 through 2005, it did not substitute for cardiac enzymes but was an addition. Traditional enzymes were routinely available to the patients independent of troponin assessment. The MI algorithm used in this paper does not include troponin.

Endpoint definition

Fatal cases (death within 28 days from onset) were classified according to the MONICA diagnostic categories as “definite MI” (F1), “possible MI” (F2), “non-MI” (F4), and “cardiovascular death with insufficient data” (F9), which includes coronary sudden deaths as a majority and some unwitnessed deaths with no alternative evident cause. Nonfatal events were classified as “definite MI” (NF1), “possible MI” (NF2), and “non-MI” (NF4). The MONICA NF2 category is a broad diagnostic group and includes minor forms of MIs, other acute coronary syndromes, angina pectoris, and typical chest pain in absence of other positive diagnostic criteria for definite MI. Successive hospitalizations on the same subject within 28 days from onset or hospitalization were considered as one event.

We considered three hierarchical endpoints of acute symptomatic CHD. The narrowest is “MONICA definite MI or fatal CHD” (F1 + NF1 + F2 + F9). An expanded category, “MONICA definite MI or fatal CHD, or MONICA possible nonfatal MI with at least one revascularization procedure (either thrombolysis or primary PCI) undertaken within the first 24 hours from symptoms onset” includes interrupted MIs and symptomatic events that would not have proceeded to MI, even without the intervention. We take the 24-hour period for the definition of this category because in the first decade only this choice is available. Finally, the MONICA “definite MI or fatal CHD or possible nonfatal MI” entity (F1 + NF1 + F2 + F9 + NF2) adds to the previous all the remaining MONICA possible MIs.

For any endpoint, 28-day case fatality is defined as the proportion of deaths within 28 days from the total number of events. For completeness we also present the CHD mortality rate (F1 + F2 + F9). The endpoints presented are for first event only (incidence rates).

Table 1
Definition and coverage of suspected in-hospital and out-of-hospital coronary events, during the entire surveillance period: The MONICA and CAMUNI MI registries, 1985–2004

Event type	Period	Source of notification	Coverage	Investigated codes
Out-of-hospital death	1985–2004	Death certificates	Italy	Underlying cause of death: ICD-IX 410–414, 798, 799; or 250, 420, 423–429, 440–449 in association with 410–414 in any other cause
Hospitalized events	1985–1988	HDD codes* (4 available)	Area hospitals (9) and major neighboring hospitals (6)	410–414 in any available field
	1989–1998	HDD codes† (4 available)		410–414 in any available field
	2003–2004	HDD codes† (6 available)		410–411 in any available field; 412–414 in the first field only

CAMUNI = Cardiovascular Monitoring Unit in Northern Italy; HDD = hospital discharge diagnosis (ICD-IX); MONICA = Multinational Monitoring of trends and determinants in Cardiovascular disease.

* Surveillance by trained nurses.

† Availability of Electronic records.

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