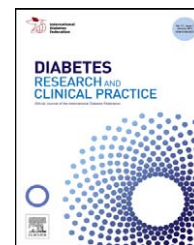




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Mortality, incidence of cardiovascular diseases, and educational level among the diabetic and non-diabetic populations in two large Italian cities

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ABSTRACT

Aims: We investigated if diabetes modifies the effect of the association of education with mortality and incidence of cardiovascular diseases.**Methods:** We identified 44,889 diabetics using multiple data sources. They were followed up from January 2002 up to December 2005, and their mortality, incidence of myocardial infarction and stroke, by educational level were analysed, and compared with those of the local non-diabetic population.**Results:** The all-cause Standardized Mortality Ratios among diabetics, compared with non-diabetics, were 170 for men and 175 for women. Standardized Incidence Ratios were 199 for myocardial infarction, and 183 for stroke in men and, respectively, 281, and 179 in women. Among non-diabetics there was a clear inverse relation with educational level for all outcomes, whereas among diabetics no significant social difference in incidence was found; slight social differences in mortality were present among men, but not among women. The effect of diabetes on social differences was enhanced in the youngest population.**Conclusions:** Diabetes increases the risk of death and the incidence of vascular diseases, but reduces their inverse association with education. This is likely related to the high accessibility and good quality of health care provided by the local networks of diabetic centres and primary care.

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1. Introduction

The prevalence of diabetes is increasing worldwide and it is a major cause of morbidity and mortality for millions of people all over the world [1]. In developed countries, the disease is more frequent in the more frail subgroups of the population, ethnic minorities, women, people with low socioeconomic status and the elderly [2–6]. To reduce cardiovascular complications and increase the survival of diabetic patients,

changes in lifestyle, appropriate drug treatment, regular glycaemic control, and the continuous surveillance of health status are necessary. In most countries, including Italy, social position has been shown to be inversely related to unhealthy behaviours [7], and to access to high quality care [8]. Thus, social inequalities in health outcomes can be expected to be greater among people with diabetes, compared with those without diabetes. Nonetheless, the few studies that have compared social differences in mortality between these two

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populations have led to contradictory results [9–14]. Apart from mortality, other cardiovascular morbidity indicators and their associations with socioeconomic factors have been less investigated [3].

A previous study conducted in Turin in the 1990s showed social differences in mortality among people without diabetes, whereas no significant differences were found among women with diabetes, and mortality was only slightly increased among less-educated men with diabetes [12]. The local network of diabetic centres seemed to play an important role in reducing social differences in health. However, concerns about the validity and the generalization of these results were raised [15]. Moreover, it is not known whether the reduced social differences in mortality in persons with diabetes, compared to those without diabetes, are due to reduced social differences in incidence or in survival. Our hypothesis is that a model of care based on free access to diabetes centres and close co-operation between diabetologists and general practitioners (GP) can reduce social differences both in incidence of diabetes complications and in mortality. To answer, at least in part, to these questions a new cohort study was conducted, improving the definition of diabetes through record linkage between different data sources, expanding the data base by including the residents of the city of Venice, and considering, in addition to mortality, incidence of myocardial infarction and of stroke.

Therefore, this study aimed to investigate whether diabetes acts as an effect modifier on the association between incidence and mortality from cardiovascular diseases and educational level in subjects living in two large cities of Northern Italy, where a spontaneous disease management model of care is active since the end of the 1970s. Furthermore, as no population data from Southern Europe on the risk of death or of developing cardiovascular disease associated to diabetes has been recently published, we also aimed to update this information.

2. Materials and methods

2.1. Study population

Data on diabetic and non-diabetic people at the end of 2001 were obtained from population registries of two North Italian cities. The Turin study population (approximately 900,000 inhabitants) was selected from the Turin Population Register (TPR), which collects data on all the residents in Turin. The TPR data are linked every 10 years to the database of national census to assign individual socioeconomic variables. The Venice study population (approximately 270,000 inhabitants) was identified using the 2001 national census which contains individual socioeconomic variables and was subsequently linked with the Health Population Database (HPD). The TPR in Turin and the HPD in Venice are routinely linked to administrative databases such as those concerning causes of death, hospital discharges, drug prescriptions, and reimbursement from payment of drugs registries. Record linkage between populations and the administrative databases is performed using a 10-step procedure based on the fiscal code in Turin and a step-wise procedure based on fiscal code, name,

surname, and birth date in Venice. As described in detail elsewhere [4,16], three data sources were employed to identify diabetic people. The first source was the file of all residents discharged from hospitals with a primary or secondary diagnosis of diabetes from January 1, 1997 to December 31, 2001. The second data source was the file of prescriptions for anti-diabetic drugs prescribed to residents from January 1 to December 31, 2003; we considered as persons with diabetes only those who had at least two prescriptions of anti-diabetic drugs. The third source was the file of all subjects who obtained exemption from payment of drugs, syringes, and glucose monitoring strips due to a diagnosis of diabetes from January 1, 1998 to December 31, 2001. The study populations included all persons who were present in at least one of three health data sources. As non-diabetic populations, we considered all the other residents of Turin and Venice. Educational level was assigned using the data from the 2001 census, and was classified into three groups: high (university/high school), medium (middle school), and low (primary school/no formal education). The analysis was restricted to residents who were ≥ 20 years of age at the start of follow-up.

2.2. Outcomes

Subjects were followed up for mortality, incidence of acute myocardial infarction (AMI) and stroke. Information on causes of death, from the local mortality registries, was limited to the underlying (primary) cause, classified according to the International Classification of Diseases, 9th Revision (ICD-9): circulatory diseases (390–459), coronary heart diseases (CHD; 410–414), cerebrovascular diseases (CVD; 430–438), and cancer (140–208).

AMI incident cases were identified through record linkage between hospital and causes-of-death-registries [17]. Hospital discharges with ICD9-CM code 410* as primary diagnosis, or as secondary diagnosis when associated with selected codes suggestive of ischemic symptoms in primary diagnosis, and deaths with the ICD9 code 410* as underlying cause were selected. Individuals without a previous hospitalization for ICD9-CM codes 410* or 412* during the previous 60 months were considered as incident cases.

Acute stroke incident cases were identified through hospital and causes-of-death registries [18]. Hospital discharges with ICD9-CM codes 430*, 431*, 434*, and 436* as primary diagnosis, excluding patients with 438* code in secondary diagnosis, and deaths with ICD9 codes 430*, 431*, 434*, and 436* as underlying cause were selected. Individuals without a previous hospitalization for stroke diagnosis during the previous 60 months were considered as incident cases.

We considered the first discharge for each subject in the period 2002–2005. We identified all discharges occurred from any hospital in Italy, thus ensuring that all people were observed 60 months before the diagnosis.

2.3. Statistical analyses

Baseline characteristics are presented and Chi-square statistical tests were used for comparing diabetic and non-diabetic subjects in Turin and Venice. The start of follow-up was defined as January 1, 2002 and ended at the date of incidence,

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