

## ORIGINAL ARTICLE

# Carbon monoxide poisoning in the home as an indicator of social integration of immigrant population

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## Key words

Carbon monoxide poisoning • Observatory • Social integration

## Summary

*Verona is a town in Veneto Region (Italy) characterised by a high socio-economic status, but we register some health problems related to low income or social deprivation, such as unintentional carbon monoxide poisoning in private houses. Recently, indeed, there has been a rise in the number of accidents concerning immigrant populations. Since early 1990s, epidemiological informations in the matter weren't complete and the number of cases was therefore probably underestimated. Presently no centralised system exists in Italy or in Veneto Region for recording the incidence of household CO poisoning. An "Observatory on CO poisonings" was therefore activated in Verona Municipality in 1994 to overcome the problem of lacking data. The Observatory systematically collects data on cases of acute household CO poisoning occurring in the whole Verona area. These informations are used to assess public health interventions.*

*During 13 years' activity 671 cases of CO poisoning and 22 deaths were recorded. The accidents were caused by the malfunctioning of home heating appliances. Statistics show a progressive increase in the number of not Italian involved in these episodes. Inspections revealed that immigrants often live in poor houses with unsafe systems or with extremely precarious heating systems.*

*Data from this surveillance system on CO poisoning have shown that this is a public health problem involving immigrants much more often than local population. This system in real time supplies epidemiological and environmental data for improving public health intervention strategies. Such data collection systems could be useful to study other relevant problems of health disparities in lower socio-economical classes.*

## Introduction

Verona is a wonderful, ancient town in Veneto, a large region in North Eastern Italy (Fig. 1). This city is also an important industrial and commercial gateway to Northern Europe. The Verona city Prevention Department (DP) attends to Public Health for the Local Health Agency (LHA 20). This Agency includes the city and rural surroundings, with a population of 446,000 persons and 36 municipalities. In the whole province of Verona (LHA 20, LHA 21 and LHA 22) live 826,000 persons. This area is characterised by a high socio-economic status; it is one of the highest income areas in Europe since pro capite income is one fifth higher than the European average.

In 2005 the employment rate (proportion between the number of people employed and total population) in the province of Verona was 65.1% with respect to the Italian national average of 57.5%. The unemployment rate (the number of unemployed individuals expressed as a percentage of the labour force) is stable at 4.4% compared with an Italian average of 7.7% [1].

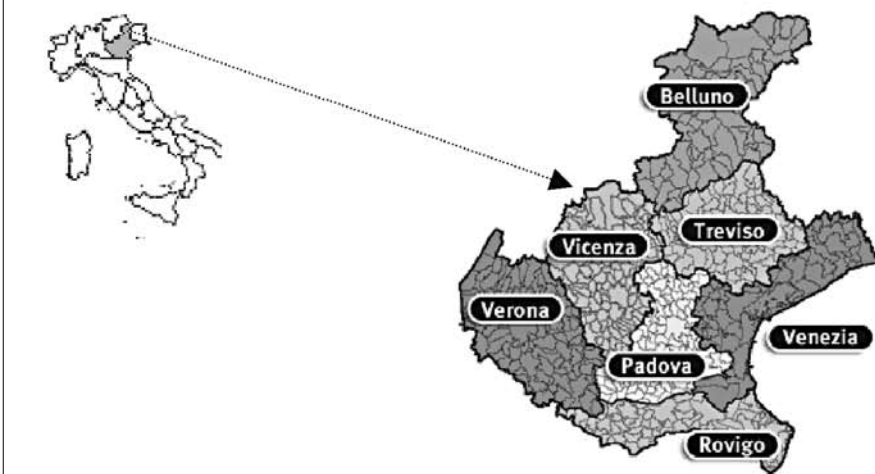
In this economic context so advanced it could seem anachronistic having to face health problems linked with situations of low income or social deprivation such as those concerning the low quality of living spaces or the inadequacy of domestic appliances. Moreover, for several decades minimum requirements have been issued for dwelling and many laws and technical rules in recent years

regulated the features of combustion systems. Despite this, episodes of unintentional carbon monoxide (CO) poisoning in private houses have continued to occur and, in fact, recently there has been a rise in the number of accidents concerning immigrant populations, episodes that were often fatal. These fatal poisons can be defined as potentially avoidable deaths since adequate prevention, treatment and rehabilitation could reduce or even eliminate them [2]. This implies that public health services should be able to analyze and measure the phenomenon, seeking the causes and defining corrective interventions [3].

Since early 1990s, epidemiological informations in the matter weren't completed, avoidable data were limited to fatalities and probably did not cover all events. The reported cases were probably grossly underestimated given the difficulty in correctly diagnosing CO poisoning, not only for the lack of the registration system but also for the inadequate attention paid to this problem both by health authorities and by the population.

The Observatory on CO poisoning was therefore activated in Verona Municipality in 1994 to overcome the problem of lacking data; it was subsequently extended to the whole Province. Here we present epidemiological data of CO poisoning that have been systematically collected from 1994 to 2006. Accordingly, Bekkedal et al. underscored the importance to develop an efficient surveillance system for CO poisoning [4].

Fig. 1. Veneto: 4,527,000 inhabitants.



## Methods

At present no centralised system exists in Italy or in Veneto Region for recording the incidence of household CO poisoning. These events, when resulting in death, are classified in the generic category of poisoning by the Italian ICD (International Classification of Diseases) registration system of all causes of death. On the other hand, by investigation of Hospital Discharge Charts, it is only possible to identify non-fatal poisoning when they result in hospital admission. So these papers exclude all those cases treated in the casualty when discharged after a few hours because of improving the patients' clinical conditions.

On the other hand, the existing information system doesn't take into account that, in the case of immigrants, it is not always easy to know the country of birth and therefore it may be difficult to identify health inequalities based on race or ethnic origin. Since immigration in Italy is a recent phenomenon and it still regards mostly first-generation immigrants, presently it is usually possible to specify their nationality on papers at hospital admission, but it will no longer be possible to obtain this information in the case of second-generation immigrants born in our country (who, generally haven't completed the social integration process and so can still present specific risk factors).

Observations have been collected by the Verona city DP. DP has also made epidemiological assessment. The purpose of the Observatory is to systematically collect data on all cases of acute household CO poisoning occurring in the whole Verona area, whether fatal or not. These informations are also necessary in order to assess what type of interventions are to be planned by health authorities. Public health services collaborated with local hospitals, which agreed to report all cases of poisoning diagnosed by Emergency Departments. In each of the three LHA one single researcher was charged to receive reports from his own area and to collect the required informations: technical causes of the accident and clinical picture in victims of poisoning. The information was registered as

a file and inserted in a database. The environmental risk factors were investigated by the Local Regional Agency for Environmental Prevention and Protection; indoor CO concentrations were measured and technical checks were made on the adequacy of the technological systems. The same agency informed the competent authorities about the measures required to remove any problem or risk factor for CO poisoning. Public Health Services then made epidemiological assessments, spread information on the health hazards of CO to local populations and promoted preventive interventions. A report on the Observatory's results was issued regularly and was distributed to all those interested in Observatory activities. These reports were also part of the annual report on the Verona city DP activities (printed and downloaded version - <http://prevenzione.ulss20.verona.it/>).

## Results

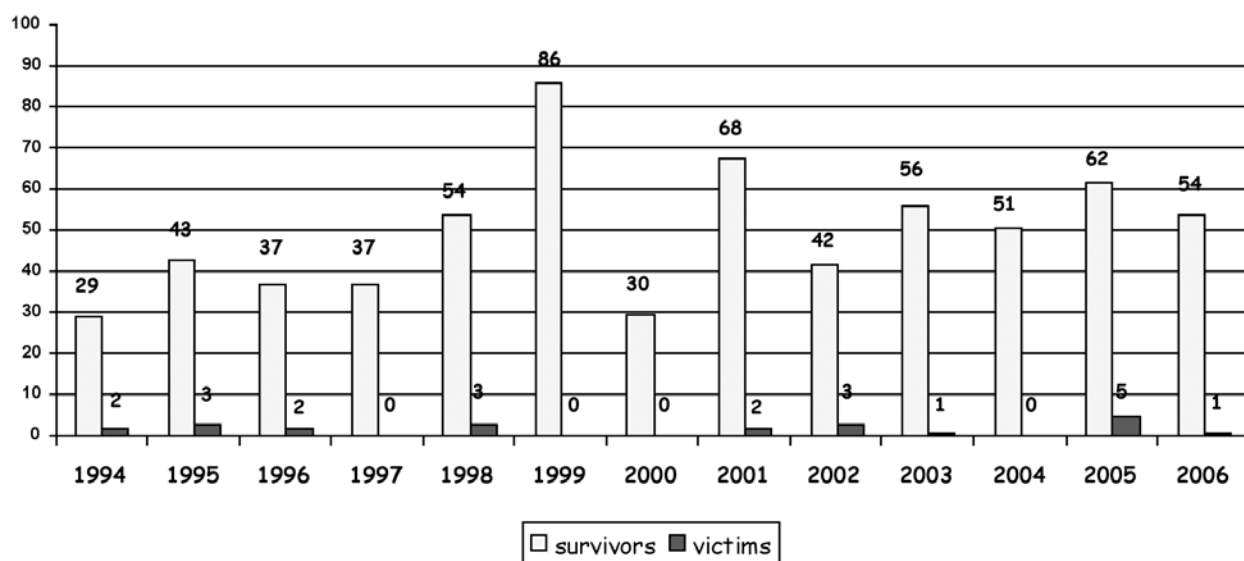
### DATA COLLECTED BY THE OBSERVATORY AND TREND OF HOUSEHOLD CO POISONING

The following chart (Fig. 2) shows the number of persons accidentally poisoned by CO from 1994 to 2006. In 13 years 671 cases of CO poisoning and 22 deaths were recorded.

The chart shows that the trend was constantly rising in the first 6 years of observation while, afterwards, the number of accidents appears almost stable. We can presume that data collected before 2000 do not correspond exactly with real mortality and actually underestimate the phenomenon as already observed by other authors [5, 6]. The scarce attention paid to this problem both by health authorities and the population during this period may have caused the under-reporting of the episodes while the discontinuity of information received by the Observatory, still in an experimental phase, may have caused problems when collecting data.

A comparison between the various information flows inside the Observatory shows that, from 2000 onwards,

Fig. 2. Number of persons suffering CO poisoning. Province of Verona 1994-2006.



there has been an improvement both in the cases identification and in information reporting.

#### RISK FACTORS

The episodes examined have made it possible to establish that accidents were caused by the malfunctioning of home heating appliances (boilers, wood stoves, hobs ...) not installed correctly or placed in unsuitable rooms (bedrooms, bathrooms) or not submitted to adequate regular inspections [7].

An emerging risk factor in poisoning was represented by the modifications made to the structure and to various systems (heating, electrical and so on) in the houses over the past 25-30 years, because of the necessity to save energy consumption. From this point of view, centralised heating systems have been replaced with individual heating systems installed in each home, the area

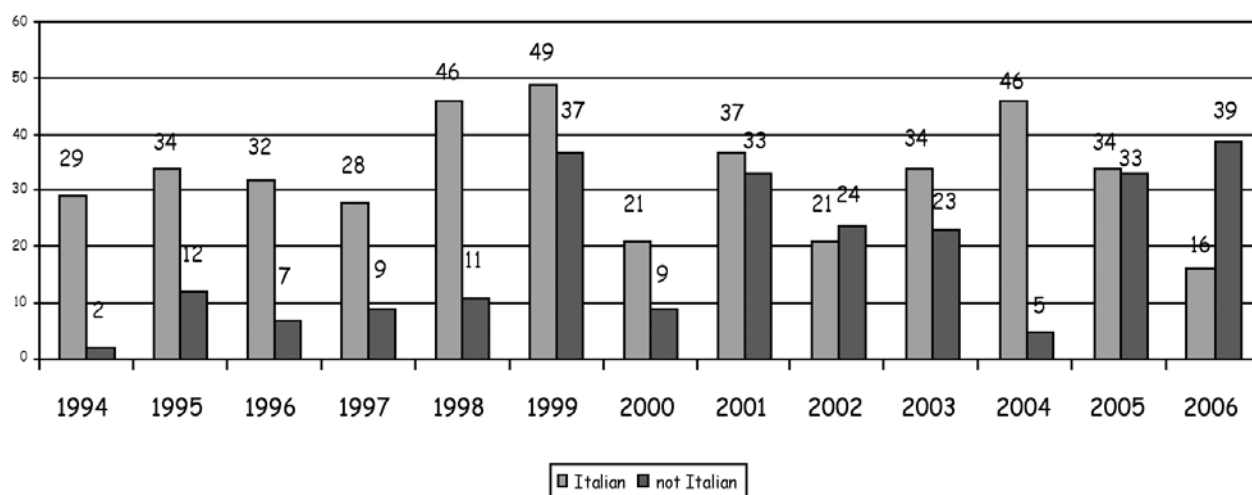
and volume of living spaces have been progressively reduced and air-tight fittings are increasingly used. This has contributed to a reduction of air exchange between the interior and the exterior, thus favouring the permanence of pollutants.

In most of the accidents we have found a lack of ventilation in the rooms where systems are installed due both to insufficient dimensions of the room and to the absence of the air vents necessary to guarantee constant renewal of the air consumed during the combustion process.

#### POPULATION INVOLVED

Statistics show a progressive increase in the number of not Italian (extra European Union people) involved in these episodes. Most cases of poisoning have been caused by precarious or obsolete heating systems. The trend of the phenomenon is shown in the following chart (Fig. 3).

Fig. 3. CO poisoning: number of persons, by nationality. Province of Verona 1994-2006.



**Tab. I.** Household unintentional CO poisoning 1994-2006 – Province of Verona – Nationality of not Italian poisoned people (number of persons).

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Tot
Eastern Europe				3		13		12	17	1	0	5	2	53
Africa	1	2	7	6	11	23	9	7	5	18	3	22	31	145
South America								4	2	0	0	1		7
Asia		10						10	0	3	0	0		23
Foreign nationality not specified	1					1				1	2	5	6	16
Total foreigners	2	12	7	9	11	37	9	33	24	23	5	33	39	244
% on total of poisoning victims	6%	26%	18%	24%	19%	43%	30%	47%	53%	40%	25%	49%	71%	36%

Data were compared with the number of immigrants living in town, which has grown progressively in the years considered. In Verona city, the number of foreigners (expressed as a percentage of total inhabitants) was 10% in 2006 while it was only 2% in 1994. Therefore CO poisoning was much more frequent in foreigners than expected considering aforementioned demographic data. Similar data were reported by other Authors [8-10].

Poisoned persons of foreign origin are mainly represented by immigrants coming from outside European Union, mostly from Africa and Eastern Europe (Tab. I). These people, from a social point of view, are part of the increasing number of workers coming from poorer countries and providing unqualified work, generally refused by native inhabitants.

#### THE HOUSING SITUATION

One of the activities planned by the Public Health Service was the visit to houses of victims and analysis of their state. Inspections revealed that immigrants for economic reasons often live in poor houses with unsafe systems or, in more serious cases, with extremely precarious heating systems such as open fires in closed rooms or in ramshackle shelters. Often poor and excluded people, especially foreigners, are forced to rent property of low quality, sometimes even in ruinous state, whose rents are similar or even higher than those paid for a normal dwelling; these “homes” (already refused by the native inhabitants) are often the only choice that market offers in the town.

The need for housing, especially in relation to the rapid and consistent rise in numbers of immigrants, is now a real social emergency in the largest cities of the region. The housing emergency is a complex problem but generally is not due to the lack of buildings but rather to the fact that many houses are not available to some categories of people: only in Verona city, according to 2001 census data [11], 2845 homes were unoccupied while 260 buildings were occupied although not classified as homes (totally precarious shelters or without the minimum hygienic requisites). Therefore, it can be reasonably assumed that these data are only the tip of the iceberg for situations that cannot be easily pointed out.

#### PUBLIC HEALTH INTERVENTIONS

Since 2000, the following public health interventions have been organized to improve living conditions and to reduce the risk of CO poisoning.

1. Community interventions: information and health education campaigns addressed to general public in order to illustrate health risks by CO poisoning and preventive measures; specific interventions addressed to immigrants using multilingual materials; awareness campaigns addressed to owners and condominium administrators.
2. Interventions to improve the flow of information toward health officers and police personnel [12].
3. Interventions addressed to specific environmental managers (engineers, architects, housing inspectors designated to control the system and so on) with the purpose of improving the quality of installations [13, 14].
4. Monitoring of unhealthy buildings, especially those located in degraded zones of the urban area. In the period mentioned, in fact, a specific program has been activated in Verona city (250,000 inhabitants), in collaboration with local authorities, to improve housing conditions at major risk with the aim to get their recovery in collaboration with the stakeholders [15].

#### Discussion

Presently the official Italian National Health Service information system does not collect systematically a number of very important epidemiological health data (e.g. the number of cases and of deaths caused by CO poisoning). In fact, so far no central system exists in Italy or in Veneto for recording and monitoring specific data on the incidence of household CO poisoning.

Interestingly, the National Health Plan for 2006-2008 encourages the development of “syndromic surveillance” to achieve early identification of public health emergencies and to enhance integration of different information systems [16].

Our observatory is able to provide all the information necessary to set up a system for CO poisoning monitoring.

The Observatory can systematically collect data that otherwise would be lost (risk factors, geographic distribution, causes of the events, ethnic groups involved) Furthermore collecting "real time" public health data speeds up identification of problems and effective interventions.

Data collected in Verona have shown that this important public health problem involves immigrants proportionally much more often than the local population. Moreover, by this system we can improve public

health intervention strategies. It would be important to activate similar projects in other Italian regions and to integrate them into the National Health Care information system; it is also necessary to study the trend of this phenomenon, in particular among immigrants. Such data collection systems, which increase data availability for early intervention planning, could be very useful to study other relevant health problems mainly in the field of health disparities in lower socio-economical classes.

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