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EDITORIAL

What is Happening to the Health of the Croatian Population?

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Aim. To describe the problems in the interpretation of Croatian mortality data and explore possible reasons for the recorded increase in mortality in the 1990-1999 period, particularly related to different methods of collection and estimation of data on deaths and population.

Methods. Numbers of recorded deaths and population estimates were first obtained from the Croatian Institute for Public Health and examined in detail. The Institute used population estimates supplied by the Croatian Statistics Bureau, which included *de jure* population data (including all Croatian citizens wherever they live) until 1996 and *de facto* population data (including only population living in Croatia at least for a year, irrespective of citizenship) since 1996. A different set of population estimates based on *de facto* estimates since 1992 was obtained from the Croatian Bureau of Statistics. We examined trends in age- and sex-specific death rates from major causes in 1990-1999 period, using the mortality data from the Croatian Institute for Public Health and both sets of population estimates. Lung cancer as a cause of death was examined in more detail, since it is relatively stable over short periods of time. Interviews were undertaken with key informants to identify the reasons for any discrepancies.

Results. In Croatia, relatively stable death rates from lung cancer in men ranged from 84/100,000 in 1990 to 79/ 100, 000 in 1995. In 1996, a marked discontinuity appeared in the Croatian data, with a 14% increase compared to 1995 (from 79/100,000 to 91/100,000) and a further increase in 1999 (94/100,000), which is not credible on the basis of the natural history of lung cancer. Analysis of mortality rates with *de facto* population estimates showed more gradual increase from 1992-1996. Methods used to estimate population and mortality during the 1990s were inconsistent and misleading. At present, it is impossible to be certain about the true level of mortality in Croatia during 1990s, as the numerator (deaths) and denominator (population) were incompatible until 1998.

Conclusion. Major problems in data collection would have been identified if the investigation of unexpected mortality trends in Croatia in the 1990s had been done. Systematic analysis of health patterns should be done as soon as data from the 2001 census become available. Capacities in public health should be strengthened to make this possible. This issue has received little recognition from the international donor organizations, particularly those that use health data.

Key words: *cause of death; Croatia; life expectancy; lung neoplasms; mortality; public health; research design; vital statistics*

In the Central and Eastern Europe, the years between 1990 and 1999 have been characterized by profound socio-economic changes, which have had important consequences for the health of their populations. These events have been described in epidemiological and demographic studies carried out in several countries (1-7) but there has been only limited research so far in Croatia (8).

This study arose from an initial intention to assess the reasons for the apparent deterioration in health in Croatia in the 1996-1999 period, as reported in the World Health Organization's (WHO) Health for All Database, which presents information on a wide range of health indicators in the European Region of WHO (9). Trends in life expectancy at birth in Croatia and Slovenia had been fairly parallel, with the exception of the war in the early 1990s, but then diverged after 1995 (Fig. 1). The reasons for this relative decline were unclear, but understanding them would have substantial implications for the health policy.

An initial examination of death rate trends in Croatia during the 1990s identified substantial increase in mortality from lung cancer, which could not be explained on the basis of the known epidemiological characteristics of the disease. In particular, pronounced increases in death rates from that and other cancers suggested questionable estimates of officially reported population and mortality data for the 1990–1999 period.

The initial analysis of mortality data obtained from the Croatian Institute for Public Health revealed

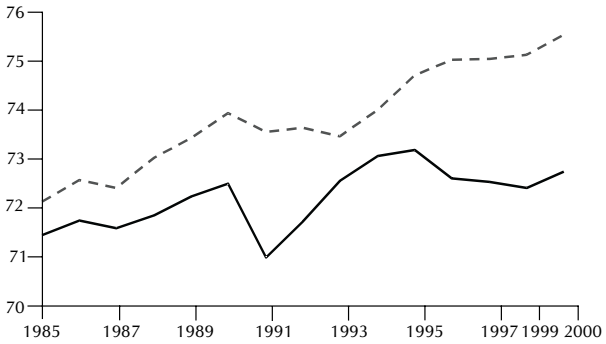

Figure 1. Life expectancy at birth (years) in Croatia (full line) and Slovenia (broken line).

that the increase in rates of certain causes of death could not be explained easily, and raised questions about the accuracy of the estimates of population and mortality data that were in use.

Monitoring mortality trends is important for several reasons. Firstly, as the major source of information on patterns of disease in a population, they show changes in health outcomes that may require a policy response. Secondly, they enable comparisons with other countries, enabling governments and those acting on their behalf to set benchmarks for health outcomes and thus to identify areas where it may be possible to learn from experience elsewhere. Thirdly, they make it possible to identify health inequalities within a country, whether regional, socio-economic, or otherwise. In particular, the observation that a cause of death is increasing should stimulate action by public health practitioners to investigate the reasons for this finding and develop an effective public health response.

Similar studies on the determinants of changes in population health have now been undertaken in several other Central and Eastern European countries, in each case identifying areas requiring a policy response (10-15).

This study aimed to explore the quality of Croatian mortality statistics during 1990s and assess the degree of uncertainty around official data on the health of the Croatian population. Such study would contribute to the development of an effective health strategy based on careful monitoring and reporting of the status of population health.

Methods

Data on the number of deaths by age, sex, and cause of death and number of inhabitants for 1990-1999 period were obtained from the Croatian Institute of Public Health (Tables 1 and 2). The Institute uses a set of population estimates from the Croatian Statistics Bureau, which consists of the *de jure* population estimates until 1996 and *de facto* estimates for the 1996-1999 period. *De jure* estimates include only Croatian citizens living in Croatia and abroad, whereas *de facto* estimates take into account only the population that lived in Croatia for at least a year, irrespective of citizenship. Age- and sex-specific death rates for 10-year age groups were calculated for the following causes of death according to the codes of International Classification of Diseases (ICD-10): HIV/AIDS (B20-B24), other infectious and parasitic diseases (A00-B99), ischemic heart disease (I21-I29), cerebrovascular diseases (I60-I69), other diseases of circulatory system (I00-I99), malignant neoplasm of bronchus and lung (C34), other malignant and benign neoplasms (C00-D48), diseases of respiratory system (J00-J99), alcoholic liver disease (K70-K74), total violent deaths, traffic accidents, and suicides. Death rates were calculated by 10-year age groups (0-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, and 70 years and more).

An initial inspection showed that age- and sex-specific death rates from almost all causes of deaths have increased since 1996. We decided to present death rates for lung cancer in men, as an example of a considerable increase in mortality. The death rate from lung cancer changes slowly because it reflects patterns of smoking many years previously (16). For this reason, and also because lung cancer is common and thus not susceptible to random variation associated with small numbers, it offers an opportunity to validate apparent changes in death rates from other causes where there are questions about the accuracy of the population and mortality data. In contrast, for many other causes, such as injuries and violence, it is clear that rates can change rapidly, as the interval between exposure to risk factors and death is short. This is illustrated by consideration of deaths from drunk driving, where a change in drinking behavior, car use, or law enforcement, may very rapidly lead to a change in deaths. Thus, unlike lung cancer, a rapid change in deaths from injuries would not be unexpected.

To elucidate the reasons for the unexpected change in lung cancer mortality, a detailed description of the sources used and the assumptions underlying them was sought from key informants in the Croatian Public Health Institute and the Bureau of Statistics. After enquiry, we received another set of population estimates from the Croatian Statistics Bureau that included *de facto* population number since 1992 (Table 1). We then undertook a

Table 1. Differing population estimates in Croatia in the period 1990-1999[a]

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999
Data used by Croatian Public Health Institute to calculate mortality rates (Includes Croatian citizens living in Croatia and abroad until 1996 – *de jure* estimates)									
Men	2,319,502	2,316,725	2,314,470	2,313,689	2,312,809	2,159,527	2,197,442	2,163,164	2,188,455
Women	2,466,610	2,465,470	2,464,155	2,463,332	2,463,203	2,334,054	2,375,032	2,337,985	2,365,314
Total	4,786,112	4,782,195	4,778,625	4,777,021	4,776,012	4,493,581	4,572,474	4,501,149	4,553,769
Alternative estimates by Croatian Statistics Bureau excluding citizens living abroad but including refugees since 1992 (*de facto* estimates)									
Men	2,318,623	2,148,320	2,230,504	2,234,233	2,243,709	as above			
Women	2,465,642	2,321,946	2,410,771	2,414,801	2,425,043				
Total	4,784,265	4,470,266	4,641,275	4,649,034	4,668,752				

[a]Source of data: The Croatian Bureau for Statistics.

Table 2. Total number of recorded deaths in Croatia in the period 1990-1999, according to the Croatian Bureau for Statistics and the Croatian Institute for Public Health

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Men	26,874	29,522	27,494	26,403	25,693	25,958	25,897	26,642	26,682	26,613
Women	25,318	25,310	24,306	24,443	23,789	24,478	24,739	25,322	25,629	25,340
Total	52,192	54,832	51,800	50,846	49,482	50,536	50,636	51,964	52,311	51,953

further analysis of mortality data according to the later set of population estimates.

Results

Mortality rates in the Croatian population are presented through the results of analysis of reported death rates from lung cancer in men in Croatia and Italy (Fig. 2). The reported death rates were calculated from data supplied to the WHO by the Croatian Statistics Bureau, which included *de jure* population estimates until 1996 and *de facto* estimates since 1996. Until 1995, the trends in Croatia and Italy were broadly comparable. Between 1990 and 1995, the rates in Croatia were relatively stable, ranging from 84/100,000 in 1990 to 79/100,000 in 1995. This downward trend was similar to that seen in many other parts of Europe (9). However, in 1996, a marked discontinuity appeared in the Croatian data, with a 14% increase compared to 1995 (from 79/100,000 in 1995 to 91/100,000 in 1996) and a further increase in 1999 (to 94/100,000). This was simply not credible on the basis of the natural history of this disease. Analysis of mortality rates using *de facto* population estimates showed more gradual increase from 1992 to 1996. Using these data, the mortality rate of lung cancer in men was calculated at 84/100,000 in 1990, with a decrease to 82/100,000 in 1995. In 1996, it was 91/100,000, or an 11% increase compared to 1995 (Fig. 3).

Interviews with key informants, seeking to explain these patterns, identified a series of unexpected problems with data on both deaths and population size, which were not taken into account in the officially reported mortality trends.

Before 1995, the population denominator used to calculate mortality rates included not only the people living in Croatia, but also Croatian citizens living permanently abroad. It was estimated that the difference was approximately 250,000 people, with about 1,500 deaths yearly among Croatians living abroad. When the Croatian Statistics Bureau obtained information on the death of a Croatian citizen abroad, the death was included in the overall mortality figure. Since the cause was not usually known, it was recorded as "unknown cause of death" (ICD-10 code R99.0). The effect of this practice would be to dilute the impact of deaths from causes that were reported precisely. Whereas all Croatian citizens, wherever they resided, would have been included in the denominator, only those dying from lung cancer *who were actually living in Croatia* would be so recorded. Consequently, data on mortality from specific causes before 1995 would be underestimates. There was, however, considerable uncertainty about the extent of ascertainment of deaths occurring abroad, so it was impossible to accurately state how large the underestimate was.

The Croatian Statistics Bureau had, however, maintained two sets of population figures. One, *de jure* population, included Croatian citizens wherever they lived. Another set of *de facto* estimates was constructed in 1996 for the years since 1992. These estimates included the people living on the territory of Croatia for at least a year, regardless of their citizenship. Croatian citizens living abroad for more then a year were excluded. Before 1996, the Croatian Public Health Institute used *de jure* population figures. In 1996, they changed to the *de facto* population data but continued to use the *de jure* definition for data on deaths until 1998. Thus they excluded deaths among non-citizens living in Croatia but included deaths of Croatian citizens abroad, although the latter were, by now, excluded from the population denominator. Thus, from 1996 to 1998, there were factors that would both increase and decrease official mortality rates, but the net effect could not be known. In addition, a further 6,691 deaths took place at some point during the war between 1991 and 1995; these were identified after the war and have not been added retrospectively to the data for earlier years. Finally, mortality data were not supplied by the authorities in the parts of Croatia occupied by Serbian forces until 1995, although those living in these regions were included in the population denominator, accounting for an estimated 6.2% of the total Croatian population.

In 1993, the situation was complicated further by the large-scale movements due to the war in Croatia (17) and neighboring Bosnia (18). The Croatian Statistics Bureau obtained data from the Croatian Office for Refugees and Displaced Persons, which recorded that 373,161 people moved from Bosnia to Croatia between 1991 and 1999. Refugees coming to Croatia

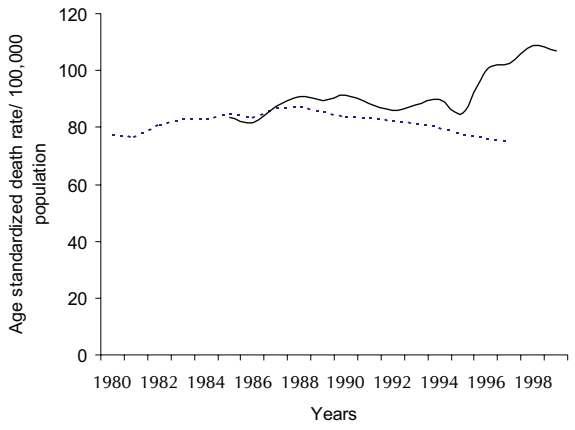

Figure 2. Officially reported trends in lung cancer death rates among men in 1990-1999 period for Italy (dotted line) and Croatia (full line).

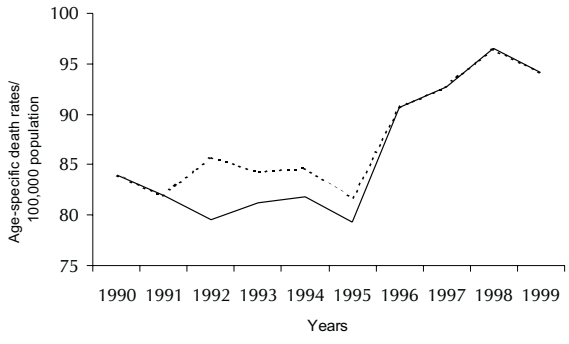

Figure 3. Death rates from lung cancer in men in Croatia by *the facto* (dotted line) and *de iure* (full line) population estimates.

during the war were included in *de facto* population estimates. However, the deaths of refugees were recorded in Croatian municipal registries of births and deaths but were not transferred to the Croatian mortality database. Thus, refugees were included only since 1998, when the Statistical Office of the European Communities (EUROSTAT) methodology was adopted (19). However, an interviewee at the Croatian Statistics Bureau suggested that although their deaths were not officially included in the Croatian mortality database until 1998, some might have been included because of the failure to adhere to official guidance at some municipal registries.

A further large-scale movement took place in 1995, when approximately 250,000 ethnic Serbs left formerly occupied territories (20). Subsequently, it was estimated that 77,846 returned to Croatia (data obtained from the Croatian Office for Refugees and Displaced Persons). It was also estimated that a further 102,686 people left Croatia between 1991 and 1999, mainly to western Europe and North America, although the preliminary results from the 2001 census, which reported the population of 4,381,352, suggested that the scale of emigration had been larger. The summary of changes in population and mortality estimates in official Croatian statistics is presented in Figure 4.

Finally, in 1998, the Croatian Public Health Institute and the Croatian Statistics Bureau changed to *de facto* definition for mortality data, to be consistent with procedures of the United Nations, EUROSTAT, European System of National Accounts, and System of National Accounts. However, the scale of migration, particularly the emigration of Croatian citizens, which was to a large extent not recorded in the preceding years, meant that the population estimates were subject to considerable uncertainty.

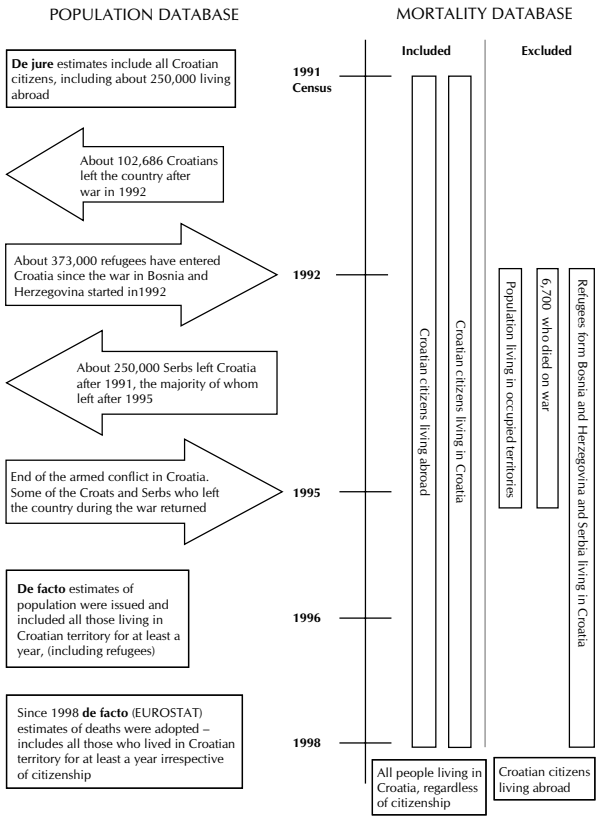

Figure 4. Summary of changes in population and mortality estimates in official Croatian statistics. Arrows show population movements and boxes contain details of the content included in each period.

Discussion

An accurate estimate of the size of population of a country and the use of the same methodology of estimating number of deaths and population is an essential first step in assessing the rates of death from different diseases. This was not the case with Croatian mortality statistics. With the information available, it was not clear what the true mortality rates for the population of Croatia during 1990s were. Because of the weaknesses of the data, the extent to which we drew our conclusions was limited. Therefore, the aim of the study was primarily to assess the validity and methodology of estimating population and mortality data in Croatia during the 1990s.

According to the preliminary 2001 census data, the total mortality rate in 2000 appeared to be about 5% higher than in 1990. There are many possible explanations to this. The first was a change in the age composition of the population, which can be resolved easily when more complete census data become available. The second was the possibility that the displaced population coming from Bosnia and Herzegovina, Kosovo, and Yugoslavia had worse health status. The third possibility was that there was the delayed effect of events in the past, such as the uptake of smoking in successive generations. Finally, it might reflect contemporary events, such as deterioration of health services in parts of the country that were greatly affected by the war and socio-economic hardship. Once comprehensive data from the 2001 census become available, it will be possible to begin to address these questions.

In the circumstances in Croatia in the early 1990s, it is inevitable there would have been some uncertainty about population numbers. This uncertainty around population health data is a major obstacle to the development of an informed response to the health challenges facing the country. In particular, it is impossible to assess how the health of Croatians compares with that of their neighbors (1-8).

These findings have several implications for policy. There is a need to clearly define which institution in Croatia is responsible for validity, analysis, reporting, and follow-up of mortality data. Also, this highlights the need for strengthened capacity in the analysis and interpretation of epidemiological and demographic data, particularly in the Croatian Public Health Institute, as it should be the key institution responsible for the analysis and interpretation of health data.

The appearance of a dramatic increase in mortality, such as that seen with lung cancer in this study and the increase in the rate of colorectal carcinoma from another study (21), should have stimulated work

to assess whether it was indeed a true phenomenon or simply data artifact, and if it was true, what were the causes.

Health policy must be evidence-based through research into the prevalence, incidence, and etiology of important health conditions and the evaluation of population-based interventions in response to them. In the present situation, where it is impossible to undertake detailed analysis of mortality data, little can be concluded about the health needs of the Croatian population. This gap in knowledge should be addressed as a priority. There is a particular need to address the challenges of non-communicable diseases, looking not only at patterns of ill-health, levels of risk factors in the population, and environmental and socio-economic determinants of health, but also at public attitudes to health and disease. There is also a need to explore the scale and nature of health inequalities, a topic that has so far received very little attention in Croatia.

This will require investment in human resources, in particular training in multidisciplinary research, drawing on epidemiology, medical statistics, health economics and behavioral sciences.

The population of Croatia has a right to know what is happening to their health. Regular reports on the health of population and making information on health indicators easily accessible can play a valuable role in raising awareness about patterns of its health and disease. This should be supplemented by easier access, ideally electronically, to relevant data so that the wider research community can contribute to resolving the challenges we face.

The study has also implications for other South Eastern European countries affected by war with resulting large-scale population movements, such as Bosnia and Herzegovina, Macedonia and Yugoslavia, as well as countries in the Caucasus, such as Armenia, Azerbaijan, and Georgia.

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