

Statistics Canada, Croatian Ministry of Health and Central Bureau of Statistics: a joint effort in implementing the 2003 Croatian Adult Health Survey

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1. Introduction

The Croatian Ministry of Health as part of an overall strategy for health system reform, launched a World Bank funded Health Systems Project. The Health Systems Project targeted the prevention of cardiovascular disease in Croatia. One important component of the Project is a survey of adults that provides a comprehensive assessment of the health of Croatians. The 2003 Croatian Adult Health Survey included topics around the access to and use of health care services, health status, and determinants of health such as smoking, physical activity, nutrition and alcohol use of Croatians.

The 2001 Croatian Census of Households conducted by the Central Bureau of Statistics was used to select a representative sample of households to be included in this survey. Survey results are representative for six officially defined regions of Croatia. The survey questionnaire was designed through consultation with many experts from the fields of epidemiology and public health, drawing on known survey instruments.

Under the management of the Canadian Society of International Health, medical doctors from the Andrija Stampar School of Public Health in Zagreb lead the Croatian Survey Project Team and Statistics Canada advised the Team on data quality and survey design. Survey collection took place during the summer of 2003, and results were officially released in December of 2003.

2. Background

Heart and vascular system diseases are a leading cause of death in Croatia. In 2000, they resulted in the deaths of 26,712 individuals, accounting for one out of every two deaths in Croatia. More specifically ischemic heart disease accounted for 35% of deaths in 2000 followed by cerebrovascular diseases at 31.4% in the total number of deaths caused by cardiovascular diseases.

There is neither a Register of Coronary Disease and Myocardial Infarction nor a Register for Apoplectic

Insultus at the national level in Croatia. Unfortunately, exact data on the spread of the most important risk factors, such as hypercholesterolemia, hypertriglyceridemia, hypertension, smoking, obesity, insufficient physical activity etc. are also not available. The information obtained on small samples of respondents indicate that incidence of such risks in Croatia is substantially higher than in the developed countries of Western Europe or the US, unfortunately information resulting from systematic epidemiological research has not been collected. Further, there have not been any systematic, periodic (*e.g.* 3-5 years) and standardized (allowing for international comparisons) studies of risk factors in a representative sample of the population which would allow for the monitoring of trends over time.

It has been known for a long time that mortality due to cardiovascular and cerebrovascular diseases in certain populations can be significantly reduced by acquiring a healthier way of life (non-smoking, proper diet and regular physical exercise, control and treating of hyperlipidemia, hypertension, diabetes etc.). Examples for this can be found not only in rich West European countries and the US, but also in some transition countries, including some of Croatia's neighbors. They have recorded favorable trends as a result of well-prepared preventive efforts. For example, in Slovenia, standardized mortality rate for circulation system diseases for all age groups in 1990 was 439.5 deaths per 100,000 citizens, only to be reduced to 330.9 in 1999. Similar trends can be seen in Czech Republic (from 645.01 in 1990 to 487.2 in 1999 per 100,000 citizens), Hungary (from 644.72 in 1990 to 588.5 in 1999 per 100,000 citizens) and Austria (from 389.5 in 1990 to 338.1 in 1999 per 100,000 citizens). Compared to the above, the same rate in Croatia increased from 551.74 in 1990 to 582.3 in 1999 per 100,000 citizens.

However, during the same period the standardized rate of mortality due to cardiovascular disease in the 0-64 age group has been steadily decreasing. In 1990, the Croatian rate was 111.2 per 100,000 people, compared to 98.86 per 100,000 in 1998. The 1998 figure was 17.8% lower than the European average and 24.9% lower than Central and East European average.

In current economic situation in Croatia, priorities of prevention of cardiovascular and cerebrovascular diseases should be focused on those who already have symptoms of coronary heart disease or cerebrovascular disease (secondary prevention) and those who are at great risk of contracting such diseases in future (primary prevention). Another key issue is promoting behaviour and lifestyles of the population that are known to eliminate and/or reduce health risks. The emphasis should be put on adopting a healthy lifestyle at an early age as well as to change habits that are injurious to health. Health promotion and education in health, primarily in primary prevention, but also in specialist and hospital health care should therefore be increased, by using of modern education methods and interactive approach. Preconditions for healthy life should be created, so that such healthy life can be more accessible and more attractive than other options. Other sectors, such as education, agriculture, economy etc., should also take part in creating of such environment. Cooperation among sectors is thus a precondition for a success.

3. Objectives

The primary objectives of the 2003 Croatian Adult Health Survey (CAHS) are to provide timely, reliable, cross-sectional estimates in order to support the work around:

- (i) developing a public health information system;
- (ii) enhancing the national efforts in health promotion with emphasis on cardiovascular disease prevention;
- (iii) cardiovascular disease risk reduction, clinical prevention, and emergency care; and
- (iv) promoting healthier lifestyles among the general population with emphasis on smoking prevention and cessation.

In addition specific goals of the survey include gathering data for six major regions of Croatia and creating a survey instrument that could be used as a benchmark for future studies. As well, key components of the survey are to aid in the development of public policy; to provide data for analytical studies that will assist in understanding the determinants of health; to collect data on the economic, social, demographic, occupational and environmental correlates of health and to increase the understanding of the relationship between health status and health care utilization.

4. Content

The main priority for the survey was to examine health status, risk factors and health care utilization with a focus on cardiovascular disease. A Steering Committee with representatives from the Croatian Ministry of Health, the Public Health Institute and the Andrija Stampar School of Public Health advised the Project Team as to the content. The survey was based on existing studies such as the CINDI, Short Form 36 and World Health Organization. Table 1 provides the content modules of the survey questionnaire.

Table 1. Content modules

Module	Description
Household	size, income, rooms, etc.
Socio-economic characteristics	age, gender, marital status, education, occupation
Physical measurements	blood pressure, pulse, height and weight
SF-36	general health, activity limitations, mental and physical problems
Access to and use of health care services	visits to doctors, specialists, dentists, etc.; difficulties in accessing services; health insurance, etc..
Chronic conditions, medication, preventative examinations	asthma, cancer, back pain, rheumatic arthritis, etc.
Smoking	daily smoking, attempts to stop, exposure to second hand smoke
Eating habits	breakfast, fat and caffeine intake, salt, fruit / vegetable consumption
Alcohol consumption	consumption, binge drinking
Physical activity	time spent for work and leisure

5. Sample design

5.1 Target population

The 2003 CAHS targets persons aged 18 years or older who are living in private dwellings in Croatia. Persons living in non-conventional dwellings, clientele of institutions, full-time members of the Croatia Armed Forces and residents of certain remote regions are excluded from this survey. The 2003 CAHS covered approximately 98% of the Croatian population aged 18 or older.

Table 2. List of counties by region and targeted sample size by design stratum

Region	City type	Population size*	County	Stratum	Samp. size
1- Northern	Town	245,000	Krapina Zagorja Varazdin Koprivnica-Krizevci Medimurje	1	711
	Municipality	325,000	Krapina Zagorja Varazdin Koprivnica-Krizevci Medimurje	2	942
2- Eastern	Town	481,000	Virovitica-Podravina Pozega-Slavonija Slavonski Brod-Posavina	3	372
			Osijek-Baranja	4	495
			Vukovar Srijem	5	249
	Municipality	410,000	Virovitica-Podravina Pozega-Slavonija Slavonski Brod-Posavina Osijek-Baranja Vukovar Srijem	6	950
3- Southern	Town	566,000	Sibenik-Knin	7	243
			Split Dalmatia	8	606
			Dubrovnik-Neretva	9	243
			Zadar	10	243
	Municipality	295,000	Sibenik-Knin Split Dalmatia Dubrovnik-Neretva Zadar	11	696
4- Western	Town	387,000	Primorje-Gorski Kotar Lika-Senj	12	751
			Istria	13	376
	Municipality	178,000	Primorje-Gorski Kotar Lika-Senj Istria	14	518
5- Central	Town	501,000	Zagreb County	15	500
			Sisak-Moslavina	16	249
			Karlovac	17	249
			Bjelovar-Bilogora	18	249
	Municipality	270,000	Zagreb County Sisak-Moslavina Karlovac Bjelovar-Bilogora	19	675
6- City Zagreb	District	779,000 4,437,000	City of Zagreb	20	1,933 11,250

* Based on the 2001 Croatian Census of Households

5.2 Definition of regions

To start with, the 2003 CAHS used the official definition of the five sub-national regions as proposed by the Central Bureau of Statistics; those five regions are groupings of counties (Table 2).

However and in order to ensure sufficient sample for the City of Zagreb, this important city has been removed from the Central region and a sixth region has been considered for the 2003 CAHS.

5.3 Stratification, sample size and allocation

For the 2003 CAHS, using the 2001 Census of Households, the six main regions have been further stratified based on city type (town/municipality) and counties to account for population differences. For the City of Zagreb, each district also formed a stratum. Overall for the 2003 CAHS the country was stratified into 20 design strata (Table 2).

To meet the survey objectives of providing reliable estimates for the six regions and taking into account anticipated non-response a sample of 11,250 units was required. Although producing reliable estimates at the regional level was a primary objective, the quality of the estimates for certain key characteristics at the country level was also deemed important. Therefore, the total sample of 11,250 units was first allocated to the six regions proportionally to the square root of the estimated population in each region; this allocation strategy balances the reliability of the estimates for both levels of geography, regional and at the country level. The sample size of each region was then proportionally allocated among the design strata. Table 2 gives the sample sizes by design stratum.

5.4 Frame, household sampling strategy

Through the cooperation of the Croatia Central Bureau of Statistics, the 2003 CAHS sample of dwellings was selected from the 2001 Census of Households under a multistage stratified cluster design.

At the first stage, a sample of towns/municipalities was independently selected within each design stratum using a probability-proportional-to-size systematic random approach (pps-systematic). The size of each town/municipality was determined as the total number of households on Census day. It should be mentioned that to ensure the selection of towns/municipalities in every county the list of towns/municipalities was implicitly stratified by county; this was achieved by simply sorting the list by county prior to applying the pps-systematic. It is also of importance to mention that such an approach allows for the selection of some large units more than once; in other words, some very large towns could have been selected more than once in the sample. If a town was selected more than once then the resulting sample size of dwellings was increased accordingly. A sample of 85 towns/municipalities was selected at first stage of selection.

At the second stage, a sample of segments was independently selected within each selected town/municipality using a pps-systematic random approach. For the City of Zagreb, a sample of segments was independently selected within each district. A segment is an area consisting of approximately 100-150 dwellings and is used to cluster the sample in order to facilitate data collection. A sample of 793 segments was selected at second stage of selection.

At the third stage, a sample of dwellings was independently selected within each sampled segment using a systematic random approach. Approximately 10-15 dwellings per segment were selected for a total of 11,250 dwellings. The households living in the selected dwellings formed the sample of households.

5.5 Sampling of interviewees

For the 2003 CAHS one person aged 18 or over per household was randomly selected using a simple random sampling approach. Interviewers (nurses) were instructed to list the first and last names of everybody aged 18 or over living in the household. Using a vector of random numbers and based on the number of eligible persons, one individual was selected at random to participate in the survey.

6. Data collection

Data collection took place between April and June 2003. A formatted paper questionnaire was administered face-to-face to respondents by trained public health nurses from the National Institute of Public Health in Croatia. Anthropometric measures such as height, weight, pulse and blood pressure were collected at the end of the interview for all respondents.

Approximately 238 public health nurses from across Croatia were hired to conduct the interviews. The work assignment demanded that they complete 2 to 3 interviews per day and to report progress to their supervisors on a weekly basis. A one-day training session for all interviewers was held prior to the collection activities.

Household addresses for every selected household under the jurisdiction of each interviewer were provided. Address labels for the questionnaires and control sheets were provided as well. Interviewers were instructed to first collect an inventory of the household members aged 18 years or older, and then according to a vector table found on each sample selection control sheet, randomly select the survey

respondent. Procedures were established to ensure all the collected information was stored in a secure environment and only those working on the project had access to the information.

As part of the first contact by an interviewer (a nurse), an introductory letter signed by the Minister of Health was presented to each selected dwelling. This letter legitimized the interviewer and explained the importance of the survey and provided examples of how the data would be used.

Interviewers were instructed to make all reasonable attempts to conduct the interviews. When the timing of the interviewer's call (or visit) was inconvenient, an appointment was made to call back at a more convenient time. If no one was home, numerous call-backs were made. Extra efforts were taken to convince individuals who at first refused. At least one contact was made to convert nonrespondents. However this was not a frequent occurrence as there was excellent cooperation for the majority of the respondents.

6.1 Response rates

After removing the out-of-scope units, a total sample of 10,766 households were selected to participate in the 2003 CAHS. Out of these selected households a response was obtained for 9,070 individuals which results in an overall response rate of **84.3%**. Table 3 gives response rates as well as relevant information required for their calculation by region and city type.

Table 3. Response rates by region and city type

Region	City type	In-scope hhlds	Resp. indiv.	Resp. rate
Northern	Town	697	646	92.7%
	Munici.	898	821	91.4%
Eastern	Town	1,058	921	87.1%
	Munici.	875	785	89.7%
Southern	Town	1,275	990	77.6%
	Munici.	668	506	75.7%
Western	Town	1,072	888	82.8%
	Munici.	490	433	88.4%
Central	Town	1,200	1,053	87.8%
	Munici.	640	578	90.3%
Zagreb	District	1,893	1,449	76.5%
Croatia		10,766	9,070	84.3%

7. Data processing, weighting and estimation

7.1 Data capture and editing

Data capture was performed by two office staff members who captured the data for 9,828 completed or partially completed questionnaires. The quality of the data capture process was monitored through systematic quality control procedures where a random sample of 10% of the questionnaires were re-captured and reconciled. Questionnaire design with pre-determined response categories facilitated capture and as well minimized error.

Most data edits were performed at the time of the interview by the interviewer. The questionnaire was designed with predefined response categories that made it impossible for interviewers to enter out-of-range values. The questionnaire was also designed to ensure a very easy to follow flow and skip patterns were kept to a minimum. Where appropriate, edits were developed and performed after data collection at Statistics Canada head office. Inconsistencies were usually corrected by setting one or both of the variables in question to "not stated".

7.2 Weighting and estimation

Each survey respondent was assigned a survey weight to represent his or her contribution to the total population. Taking into account the sample design, estimates are produced from the survey data by using estimation techniques from survey sampling theory. A description of the weighting strategy is provided next.

SW1–First stage sub-weight1

The first stage sub-weight is computed to reflect the probability of selection of towns/municipalities. It is computed by taking the inverse probability of selection divided by the number of towns/municipalities selected in a design stratum.

SW2–First stage sub-weight2

This sub-weight is computed to reflect the selection of segments (area made of 100-150 dwellings) within selected towns/municipalities/districts by taking the inverse probability of selection divided by the number of segments selected in a sampled town/municipality.

SW3–First stage sub-weight3

This sub-weight is computed to reflect the selection

of dwellings within selected segments by taking the inverse probability of selection of a dwelling.

W123–Dwelling-level weight

The dwelling-level weight is obtained by multiplying the first three sub-weights for all sample units.

W4–Removal of out-of-scope units

Among all dwellings sampled, a certain proportion of them were identified during collection as being out-of-scope. Dwellings demolished, vacant, seasonal, institutions or non-conventional dwellings, are examples of out-of-scope cases for the 2003 CAHS. Records for these dwellings were removed from the sample, leaving only in-scope dwellings. The in-scope dwellings kept the same weight as in the previous step, which is now called *weight W4*.

W5–Household nonresponse

During data collection, a certain proportion of selected households inevitably resulted in non-response. This usually occurs when a household refuses to participate in the survey, provides unusable data, or cannot be reached for an interview. Weights of non-responding households were distributed to responding ones using response propensity classes. These classes were formed using characteristics known for both responding and non-responding households which would best split the sample into groups that were dissimilar with respect to response/non-response. For the 2003 CAHS the groups were formed using geographic information, namely region and city type (town/municipality). An adjustment factor was therefore calculated within each class as follows:

$$\frac{\text{Sum of weight W4 for all households}}{\text{Sum of weight W4 for all responding households}}$$

The weight W4 for responding households was multiplied by this factor to produce the weight W5. Non-responding households were dropped out of the process at this point.

W6–Creation of person-level weight

Since the ultimate sampling unit for the 2003 CAHS is a person, the household-level weights computed up to this point needed to be converted down to the person-level. The adjustment factor was therefore the number of eligible persons in the household. The household-level weight W5 was multiplied by the

adjustment factor derived here resulting in the person-level weight W6.

W7–Post-stratification

The final step necessary to obtain the final 2003 CAHS weight was the post-stratification. Post-stratification was done to ensure that the sum of the final weights corresponds to the population counts defined at the region level, for all 6 age-sex groups of interest, that is, the three age groups 18-39, 40-64, 65+, for both males and females.

The population estimates were based on the 2001 Census of households counts by taking the total number of individuals living in private households in a given age-sex group in a given region. It is important to mention that any growth and/or decrease in the population between Census day and the time of the 2003 CAHS data collection was not taken into account; population projections were not available. The weight W6 was therefore adjusted to obtain the final weight W7 with the help of the adjustment factor defined as follows:

$$\frac{\text{Pop.countfortheregion – age – sexgroupoftheresp.}}{\text{SumofweightsW6fortheregion – age – sexgroupoftheresp.}}$$

Consequently, the weight W7 corresponds to the final 2003 CAHS sampling weight.

7.3 Variance estimation

As the 2003 CAHS used a complex multistage survey design, the bootstrap re-sampling method was used to compute standard deviations. The bootstrap re-sampling method used in the 2003 CAHS involved the selection of simple random samples known as replicates, and the calculation of the variation in the estimates from replicate to replicate. In each stratum, a simple random sample of (n-1) of the n clusters was selected with replacement to form a replicate (Rust and Rao, 1996). In each replicate, the survey weight for each record in the (n-1) selected clusters was recalculated. These weights were then post-stratified according to demographic information in the same way as the sampling design weights in order to obtain the final bootstrap weights (Yeo, Mantel and Liu, 1999).

The entire process (selecting simple random samples, recalculating and post-stratifying weights for each stratum) was repeated B times, where B is large. The 2003 CAHS used B=500, to produce 500 bootstrap weights. To obtain the bootstrap variance estimator, the point estimate for each of the B samples must be

calculated. The variance of these estimates is the bootstrap variance estimator.

8. Conclusion

The development, design and implementation of the 2003 CAHS required the participation of several organizations. Led by the Canadian Society of International Health, the Croatian Ministry of Health, the Croatian Central Bureau of Statistics, the Andrija Stampar School of Public Health, the National Institute of Public Health and Statistics Canada joined forces and shared expertise to successfully accomplish a high quality population health survey which will provide for the first time comparable data at a regional level.

Using the data from CAHS, health care professionals and policy makers across Croatia will be able to produce in-depth analysis in support of the development of a national promotion strategy to improve the health of Croatians.

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10. References

Rust, K.F. and Rao, J.N.K. (1996). "Variance estimation for complex surveys using replication techniques", *Statistical Methods in Medical Research*, 5, p. 281-310.

Yeo, D., Mantel, H. and Liu, T.P. (1999). "Bootstrap Variance Estimation for the National Population Health Survey", *Proceedings of the Survey Research Methods Section, American Statistical Association*, Baltimore, August, 1999.