



**Azerbaijan Republic
Ministry of Health**

Cancer Incidence and Mortality in the Industrial City of Sumgayit, Azerbaijan:

A Descriptive Study

EXECUTIVE SUMMARY

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Preface

This document summarizes the development, conduct, and findings of the joint WHO-UNDP project, “Cancer Incidence and Mortality in the Industrial City of Sumgayit, Azerbaijan: A descriptive Study.”

A detailed presentation of the study and its findings can be found in the above titled Masters thesis written by:

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The thesis is also available as a 252-page Adobe Acrobat .pdf file at the following URL:

<http://www.phs.ualberta.ca/staff/soskolne/PDF%20Files/Thesis-FINAL-UofA-Lodged-Jan6-2003.pdf>

Acknowledgements

This study was first conceived by Dr. Colin Soskolne and Ms. Francesca Racioppi, of the University of Alberta, and the World Health Organization (WHO) European Centre for Environment and Health, respectively. Without their major and sustained contributions to the development and conduct of the study, this project would not have been possible. Further thanks are owed to the supervisory committee of James Andruchow, including Dr. Ambikaipakan Senthilselvan, Dr. Nicola Cherry, and Dr. Heather Bryant. Special thanks go to Dr Roberto Bertollini, Director of the Division for Technical Support – Health Determinants, of the WHO Regional Office for Europe, who initiated the process which eventually resulted in this study.

A number of agencies contributed to the conduct and success of the Sumgayit Cancer Study. Thanks are given to the United Nations Development Programme (UNDP), that provided the funds for the conduct of this study, and to the World Health Organization European Centre for Environment and Health (WHO-ECEH) for its development of the project, and to the following agencies for their support and cooperation: the Azerbaijan Republic Government, particularly the Ministry of Health (MoH) and State Committee of Statistics (SCS), the Azerbaijan National Oncological Centre. The contributions of the WHO Azerbaijan Liaison Office, and the Sumgayit Centre for Environmental Rehabilitation must also be acknowledged.

In addition to the funds provided in large part by the UNDP through the WHO, it is acknowledged that support to the travel of James Andruchow to and from Azerbaijan was provided by the Edmonton Consular Corps Consular Ball Scholarship.

In particular, the thesis could not have been completed without the direct involvement and hard work of the following key individuals: Emin Makhmudov, Anar Asadov, Hiroko Takasawa, Oktay Akhundov, Fuad Mardanli and Arif Islamzadeh

Key Findings:

- Cancer rates in the city of Sumgayit are elevated relative to the rest of Azerbaijan. Current best estimates place the excesses as follows:
 - ¹Incidence rates:
 - All cancers combined: 22%-51% higher
 - Cancer of the larynx: 7% lower to 39% higher
 - Cancer of the trachea, bronchus & lung: 30%-67% higher
 - Cancer of the urinary bladder: 64%-149% higher
 - Cancer of the female breast: 16%-21% higher
 - ¹Mortality rates:
 - All cancers combined: 8% higher
 - Cancer of the larynx: 3% lower
 - Cancer of the trachea, bronchus & lung: 7% higher
 - Cancer of the urinary bladder: 46% higher
 - Cancer of the female breast: 4% lower
- For each of the selected cancer sites (excluding female breast cancer), Sumgayit demonstrated the highest cancer rates of the regions studied. Ganja had somewhat lower rates, while rates in Lenkoran-Astara were considerably lower
- Cancer incidence rates in Sumgayit and Azerbaijan are comparable to the neighbouring countries of Armenia and Georgia, while considerably lower than those in the Russian Federation
- Cancer incidence and mortality rates in Sumgayit are one-third to one-half of those in Canada
- Evidence suggests that the lower than expected cancer rates observed in Azerbaijan are most likely artifactual because of underreporting
- The strength of conclusions that could be made from the study was greatly reduced by missing and low-quality data
- Population size data supplied by the State Committee on Statistics (SCS) for the national population of Azerbaijan, as well as for the selected study regions of the country are based on an single demographic distribution which is not representative of regional differences, thus making valid age and sex adjustments for regional differences impossible

¹ Note: Two estimates of risk are provided for incidence because two separate analyses were conducted, one on crude incidence data for 1980-2000, another on age-sex specific incidence data for 1995-2000. A single estimate is provided for mortality because only crude mortality data were available for the study period 1980-2000.

- The capacity building initiative was only partially successful, in that local Azeri persons involved in the study have received practical experience in the conduct of epidemiological research, but have not yet independently proposed or conducted new research
- Study findings are to be presented in an interactive workshop in Azerbaijan in February 2003, designed to further expand knowledge and stimulate interest in environmental epidemiological research
- A textbook acting as a guide to the practical aspects of developing and conducting an epidemiological research study has been produced and will be disseminated in both Azeri and Russian languages in Azerbaijan
- Three manuscripts for submission to peer-reviewed journals are currently being prepared, entitled:
 - Cancer incidence and mortality in the industrial city of Sumgayit, Azerbaijan: A descriptive study
 - Presents the results of analyses of cancer incidence and mortality rates in Sumgayit and Azerbaijan relative to selected national and international comparisons
 - Environmental epidemiology capacity building in Azerbaijan
 - Discusses the strengths, weaknesses and outcomes of the international collaborative capacity building initiative
 - Data quality issues for occupational and environmental cancer epidemiology research in a Newly Independent State: The case of Azerbaijan
 - Discusses data quality issues uncovered in the study and their implications for future health research in nations such as Azerbaijan

Executive Summary of the Study

Background

The city of Sumgayit was founded with the intent of becoming a major industrial production centre for the former USSR. A policy of intensive industrial development beginning in the 1940s persisted into the 1980s, without adequate consideration of environmental and occupational safety standards. Priority was placed on maximizing production, rather than on environmental or occupational health, and consequently the environment bore the consequences of the unregulated development. By the early 1990s, the situation in Sumgayit became dire as both economic and environmental problems raised concerns to crisis levels.

The government of Azerbaijan sought international support to aid in the economic and environmental rehabilitation of the city. Partnerships were formed with several United Nations organizations, including the United Nations Development Programme (UNDP) and the World Health Organization (WHO). One of several initiatives by the UNDP aimed at improving the situation in Sumgayit was the creation of the Sumgayit Centre for Environmental Rehabilitation (SCER), a centre designed to research and prioritize the environmental problems facing the city, and to propose methods of addressing them. As part of this UNDP project, a public health component was developed, and an Inter-Agency Agreement was established between the UNDP and the WHO to support the implementation of activities in this field of environmental health. These included the conduct of two Environmental Epidemiology courses in the capital city of Baku with the goal of further strengthening the capacity of local experts, and novice investigators in particular, to examine health concerns themselves.

The research project, “Cancer incidence and mortality in the industrial city of Sumgayit, Azerbaijan: A descriptive study,” (henceforth referred to as the ‘Sumgayit Cancer Study’) was first conceived during the conduct of joint UNDP-WHO epidemiology course in December 2000. While conducting the course, two of the course instructors, Dr. Colin

Soskolne and Ms. Francesca Racioppi, had the opportunity to visit the UNDP-funded Sumgayit Centre for Environmental Rehabilitation.

While examining the pollution data collected by the Sumgayit Centre, Dr. Soskolne and Ms. Racioppi recognized the long-term environmental and occupational exposures plaguing Sumgayit. Furthermore, they were able to examine some cancer data for the city of Sumgayit, which appeared to show higher than expected rates of cancer. Given the potential link between high degrees of environmental and occupational pollution and increased cancer burden in the city, a study examining the cancer experience in the city of Sumgayit was proposed.

Rationale and Objectives

The study was designed as a means to confirm or deny, based on available evidence, the perceived increased health risks resulting from past and present industrial activities in Sumgayit, by examining the disease burden in the local population. The conduct of the study was seen also as an opportunity to provide a practical training component as an extension of the UNDP-WHO epidemiology courses, whose primary purpose was to build local capacity in environmental epidemiology research.

The primary objective of this study was to provide a quantitative, evidence-based assessment of perceived negative health effects in the city of Sumgayit resulting from decades of intense and unregulated pollution. Public fears persist that high levels of exposure to a number of toxic substances generated by Sumgayit industry have compromised human health; however, no scientific studies had been conducted to examine these concerns. Evidence was needed to support government and policy makers in setting priorities for allocating resources and for designing public health intervention programmes. Determining if Sumgayit carries an additional cancer burden because of past and present industrial activities would provide an evidence-based assessment to support or dismiss the widely held perception that industrial pollution negatively affected the health of Sumgayit residents.

This study aimed to provide the residents of Sumgayit, as well as the Governments of Sumgayit and Azerbaijan, with factual information relating to the perceived health risks associated with exposures from Sumgayit industry. The results of this study are to be used to provide a basis for recommending public health interventions, and/or further research, including secondary and tertiary prevention programmes and possible case-control studies in the city of Sumgayit and/or Azerbaijan as a whole.

A second major objective of this project was to build local capacity for epidemiological research by acting as a practical extension of the UNDP-WHO sponsored environmental epidemiology courses. To impart experience to local researchers, this study involved hands-on participation in epidemiological research by several local Azeri professionals who attended the courses, providing them an opportunity to learn first-hand about the practical conduct of epidemiological research. It was hoped that through their involvement in this study they would have gained the skills necessary to propose and conduct original epidemiological research. Such trained local researchers would be invaluable to advancing public health in Sumgayit, and in Azerbaijan as a whole.

Study Design

The primary goal of the study was to test the study hypothesis:

Cancer incidence and mortality rates in the city of Sumgayit over the period 1980-2000 do not differ from those of:

- 1) Other selected regions of Azerbaijan (Ganja, Lenkoran-Astara)
- 2) Azerbaijan national data
- 3) The Caucasus nations of Georgia and Armenia
- 4) Canada

To test the hypothesis in a cost-effective and efficient manner, as well as to better involve and train local researchers in the conduct of the research, a descriptive study design was chosen. The descriptive study design utilized population-level annual summary cancer

data and demographic information collected at the regional (rayon) level over the period 1980-2000, supplemented with lifestyle survey data, to permit comparisons of cancer incidence and mortality rates between the city of Sumgayit and selected reference populations.

The primary contrast is that of Sumgayit to the Azerbaijan national data, although comparisons are made with other selected regions of Azerbaijan (Ganja and Lenkoran-Astara). Selected data are also compared between Sumgayit and the neighbouring Caucasus countries of Armenia and Georgia, as well as with the Russian Federation. A final contrast is made between cancer rates in Azerbaijan and in Canada. Comparisons made across populations within Azerbaijan were useful for testing the internal validity of the study, while international comparisons tested the external validity of study findings.

Certain cancer sites were selected for study according to both their frequency and etiology. Laryngeal (ICD-9: 161), lung (ICD-9: 162), urinary bladder (ICD-9: 188), and all neoplastic conditions (ICD-9: 140-208) were selected because they occur with sufficient frequency to generate stable rates for analysis, while being related to environmental and occupational exposures. Female breast cancer (ICD-9: 174) was selected as a control to evaluate cancer reporting between regions, because it does not have strong associations with environmental and occupational exposures. Childhood neurological cancers and leukemias (ICD-9: 191, 192, 204-208) were also selected as indicators of environmental exposure.

Methods

Regional cancer data were collected from the archives of the Azerbaijan Republic Ministry of Health in Baku. Hardcopy summary cancer reports submitted to the Ministry of Health from cancer dispensaries in each rayon were reviewed to obtain the required cancer incidence and mortality data. Unfortunately, cancer data spanning all regions and years requested were not available directly from the Ministry of Health archives.

Attempts were made to locate missing data by contacting local oncological dispensaries in each of the study regions.

Annual numbers of incident cases and deaths were collected for the selected cancer sites. It must be noted that breast cancer mortality was recorded in a combined category (ICD-9: 174, 175), where male breast cancer (ICD-9: 175) and female breast cancer (ICD-9: 174) mortality were lumped together. Attempts were also made to collect data for childhood cancers from the Ministry of Health archives, although these data were generally of poor quality and/or unavailable. Consequently, a further effort to collect childhood cancer data was made by visiting the Children's Oncological Centre in Baku. Regional total numbers of cases and deaths from childhood neurological cancers and leukemias were obtained from hardcopy individual case histories.

Population data for each of the study regions were provided in electronic form by the Azerbaijan Republic State Committee on Statistics. Population sizes were supplied by sex and 5-year age groups for each year over the period 1980-2000 in order to provide denominators for rate calculations. Crude cancer incidence rates for several of the cancer sites being studied were obtained for selected international populations of interest from the World Health Organization's European Health for All Database.

Two independent surveys were conducted in Azerbaijan to estimate the prevalence of selected confounding lifestyle factors, including age, diet, smoking, alcohol consumption, and family history of cancer. The first survey was conducted by students in the city of Sumgayit, the second by the SCS in all three study regions: Sumgayit, Ganja, and Lenkoran-Astara. The student-administered survey had two major goals: one, to act as a pre-test of the questionnaire to be used by the SCS; and two, to validate the results of the survey conducted by the SCS. The questionnaires were presented in either Azeri or Russian.

The analysis of the collected cancer data was complicated somewhat by the temporal and regional variations in data quality and availability. Therefore, several different methods were used to analyze cancer incidence and mortality data for each of the cancer sites.

Both crude and age-standardized cancer incidence rates were plotted to aid qualitative analyses of regional differences. In addition, the statistically robust multivariate Poisson regression analysis, which accounts for the variables area, year, sex, age, and selected interactions between these variables was also utilized to analyze subsets of the data. Unfortunately, the age and sex-specific cancer incidence data required for detailed multivariate Poisson and Standardized Incidence Ratio (SIR) analyses were available only for all study regions for the period 1995-2000. Univariate analyses of cancer incidence and mortality were thus conducted on the crude data collected for the entire study period (1980-2000) to provide a long-term summary of cancer risk in Azerbaijan.

Owing to data restrictions, less statistically rigorous methods were also utilized to provide a more complete overview of the cancer experience in Azerbaijan.

Mortality:Incidence Ratios (MIRs), Proportional Incidence Ratios (PIRs), and Proportional Mortality Ratios (PMR) were also conducted on the available crude cancer incidence and crude cancer mortality data for the entire study period (1980-2000).

Results

While statistically significant excesses of cancer incidence and mortality are present in Sumgayit, it is important to note that these excesses occur only in consistent fashion beginning in the early 1990s, and that during the 1980s, Sumgayit rates are unremarkable in comparison to the rest of the country. Therefore, the estimates of cancer risk obtained for Sumgayit depend largely on the time period studied. The most rigorous analysis of cancer data used in the study is the Poisson regression technique, and will be the focus of discussion in this summary.

Multivariate Poisson regression analyses had to be restricted to 1995-2000, because of a lack of age-specific data prior to this time; and given the temporality evident in the cancer rates, the rate ratios produced by these analyses tend to be larger than those calculated from the Poisson regression analysis of crude data which spans the period

from 1980-2000. Consequently, two risk estimates representing a range in which the true cancer risk falls will be listed for incidence data (Table 1).

Table 1. Cancer incidence risk ratios for selected cancer sites and regions of Azerbaijan generated by Poisson regression analysis for two time periods (1980-2000 and 1995-2000).

Region	Rate Ratio Estimates for Cancer Incidence by Time Period			
	1980-2000		1995-2000	
	RR	95% CI	RR	95% CI
All Cancers Combined				
Sumgayit	1.22	(1.19, 1.26)	1.51	(1.43, 1.58)
Ganja	1.04	(1.01, 1.07)	1.27	(1.20, 1.34)
Lenkoran-Astara	0.67	(0.64, 0.71)	0.84	(0.79, 0.90)
<i>All other regions</i>	<i>1.00</i>	<i>-</i>	<i>1.00</i>	<i>-</i>
Laryngeal Cancer				
Sumgayit	0.93	(0.79, 1.10)	1.39	(1.04, 1.85)
Ganja	0.98	(0.84, 1.15)	1.12	(0.82, 1.53)
Lenkoran-Astara	0.56	(0.40, 0.78)	0.67	(0.44, 1.02)
<i>All other regions</i>	<i>1.00</i>	<i>-</i>	<i>1.00</i>	<i>-</i>
Lung Cancer				
Sumgayit	1.30	(1.20, 1.40)	1.67	(1.45, 1.92)
Ganja	1.16	(1.07, 1.25)	1.49	(1.29, 1.73)
Lenkoran-Astara	0.50	(0.42, 0.61)	0.75	(0.61, 0.93)
<i>All other regions</i>	<i>1.00</i>	<i>-</i>	<i>1.00</i>	<i>-</i>
Urinary Bladder Cancer				
Sumgayit	1.64	(1.43, 1.89)	2.49	(1.93, 3.22)
Ganja	0.87	(0.72, 1.05)	1.35	(0.97, 1.88)
Lenkoran-Astara	0.49	(0.33, 0.74)	0.72	(0.45, 1.16)
<i>All other regions</i>	<i>1.00</i>	<i>-</i>	<i>1.00</i>	<i>-</i>
Female Breast Cancer				
Sumgayit	1.16	(1.06, 1.26)	1.21	(1.04, 1.40)
Ganja	1.35	(1.25, 1.46)	1.44	(1.26, 1.65)
Lenkoran-Astara	0.55	(0.45, 0.66)	0.59	(0.47, 0.72)
<i>All other regions</i>	<i>1.00</i>	<i>-</i>	<i>1.00</i>	<i>-</i>

Rate ratios (RR) in Sumgayit are generally larger for cancer incidence than for cancer mortality, although both measures tend to follow a similar pattern. The most profound excess risk in Sumgayit occurs for urinary bladder cancer incidence ($1.64 < RR < 2.49$), while lung cancer incidence demonstrates the next highest risk increase ($1.30 < RR < 1.67$). The category of all cancers combined demonstrates the third most elevated risk ($1.22 < RR < 1.51$). There is limited evidence for increased risk of both laryngeal ($0.93 < RR < 1.39$) and female breast cancers ($1.16 < RR < 1.21$) in Sumgayit.

The selected cancer sites demonstrate a similar pattern of risk when mortality rates are considered, although the rate ratios do not differ as substantially from unity (Table 2). Ranked in order of decreasing risk, they are as follows: urinary bladder (RR = 1.46), all cancers combined (RR = 1.08), lung (RR = 1.07), larynx (RR = 0.97) and female breast (RR = 0.96). The estimates for cancer mortality are most likely lower than for incidence data from 1995-2000 because they are based on crude data for the entire study period, 1980-2000. When comparing mortality risk estimates to those based on crude incidence data over the same period (1980-2000), the rate ratios are more similar.

Table 2. Cancer mortality risk ratios for selected cancer sites and regions of Azerbaijan generated by Poisson regression analysis of crude mortality data for the time period (1980-2000).

Region	Rate Ratio Estimates for Crude Cancer Mortality (1980-2000)	
	RR	95% CI
All Cancers Combined		
Sumgayit	1.08	(1.04, 1.12)
Ganja	1.07	(1.04, 1.11)
Lenkoran-Astara	0.68	(0.64, 0.73)
<i>All other regions</i>	<i>1.00</i>	-
Laryngeal Cancer		
Sumgayit	0.97	(0.80, 1.18)
Ganja	1.15	(0.96, 1.38)
Lenkoran-Astara	0.59	(0.39, 0.60)
<i>All other regions</i>	<i>1.00</i>	-
Lung Cancer		
Sumgayit	1.07	(0.98, 1.17)
Ganja	1.24	(1.14, 1.35)
Lenkoran-Astara	0.48	(0.39, 0.60)
<i>All other regions</i>	<i>1.00</i>	-
Urinary Bladder Cancer		
Sumgayit	1.46	(1.23, 1.74)
Ganja	0.91	(0.73, 1.13)
Lenkoran-Astara	0.53	(0.33, 0.84)
<i>All other regions</i>	<i>1.00</i>	-
Female Breast Cancer		
Sumgayit	0.96	(0.85, 1.09)
Ganja	1.48	(1.34, 1.64)
Lenkoran-Astara	0.66	(0.52, 0.84)
<i>All other regions</i>	<i>1.00</i>	-

Incidence and mortality rates for lung cancer, female breast cancer, and all cancers combined in both Azerbaijan and Sumgayit are lower than those of either Armenia or Georgia. From analysis of available data, there is no evidence to suggest that either Sumgayit or Azerbaijan suffer from an increased cancer burden relative to the other

Caucasus nations. In comparison with Canada, cancer rates in Azerbaijan are only one-third to one-half those of Canadian rates.

Data collected for the lifestyle surveys suffered from a number of omissions and data quality issues, including the surveys conducted by the SCS. These points were raised with the Ministry of Health and despite several attempts to obtain the needed information, nothing was received. Nonetheless, the results generated from the available lifestyle survey data do not provide any evidence to suggest that the observed increased cancer risk in Sumgayit is owing to lifestyle factors.

Discussion

Because similar risk estimates are obtained from analyses of cancer incidence and cancer mortality for the selected cancer sites, it provides more confidence that these results are true reflections of the actual cancer risk in Sumgayit. Therefore, it seems reasonable to conclude that Sumgayit does demonstrate an increased risk for cancer, particularly for cancer of the urinary bladder cancer, lung, and all cancers combined. Although there is some evidence for increased laryngeal and female breast cancer risk in Sumgayit, it is not as convincing as for the previously mentioned sites. Results are consistent with a publicly perceived increased risk of disease in Sumgayit. In fact, Sumgayit demonstrates the highest incidence and mortality rates of all the study regions for each of the selected cancer sites, except for female breast cancer, for which Ganja has the highest rates.

The possibility that the observed cancer rates are the result of differential cancer detection and reporting in the study regions cannot be ignored. The use of breast cancer as a control to evaluate the uniformity of cancer data recording among regions provides some evidence for better reporting in urban than rural areas, as both Sumgayit and Ganja demonstrate higher breast cancer rate ratios. However, the degree of elevation is not as great as for other cancer sites, suggesting that if differential reporting occurs, its effect is not likely to be a major one. Differential reporting would most likely occur because of regional differences in health care quality, availability, and/or accessibility.

International comparisons suggest that both geographic region and cultural difference play roles in influencing cancer risk. Cancer incidence rates are more similar among the Caucasus nations of Georgia, Armenia, and Azerbaijan than when compared to the Russian Federation. This result may be partially explained by similarities in certain social and economic factors, having been member states of, and later seceded from the former USSR. The higher rates observed in the Russian Federation may be the result of better funding and organization of the health care system, particularly in the period following the dissolution of the USSR, and consequently, better reporting of incident cases and deaths.

It must be noted that the incidence rates calculated in the study for lung, female breast, and all cancers combined for the nation of Azerbaijan match those recorded by the WHO-HFA database almost perfectly. This result is to be expected if the data provided for this study are the same as those provided to the WHO. While some small variations exist, they are not substantial enough to cause concern. This lends credibility to the calculations made in this study, and to the data provided by the Ministry of Health. Although the data may suffer from a number of shortcomings, the consistency shown between WHO-published results and those from this study support the belief that the data used in this study are the best available.

Cancer incidence and mortality rates in the former Soviet Union, and particularly in Azerbaijan, are low relative to the Western world, as represented by Canada. Two simple, but not mutually exclusive possible reasons exist for this observation. The first is that cancer rates in Azerbaijan are indeed lower owing to some combination of decreased cancer risk, in terms of exposures and lifestyle, and/or a genetic predisposition to cancer resistance. The other is that the lower cancer rates observed are not attributable to differences in risk, but rather are artifactual, because of differential reporting and/or recording of cancer data. The bulk of evidence currently favours an explanation relating to disparities in cancer data quality across nations.

The difficulty faced in making available adequate levels of funds for health care or primary prevention has led to deteriorating medical facilities, equipment, and problems in updating curricula and training medical staff. This combination of negative factors, likely contributes to a significant number of cancer cases and deaths being missed by the health care system. This would most likely occur through an inability to diagnose correctly oncological diseases, misdiagnoses, and the poor reporting of cancer cases and deaths, because a significant portion of referrals may be on an informal basis, and because many patients may not seek treatment at all given their lack of financial resources.

An attempt was made to contact thirteen experts on health care and/or cancer registration in Azerbaijan via email, posing various questions that would stimulate informed responses to many of the questions raised by the Sumgayit Cancer Study regarding cancer data recording and reporting. Only two of the thirteen responded. As such, only two opinions were given on a relatively narrow scope of the questions posed, and no strong arguments for or against the possibility of low data quality and poor cancer reporting could be made.

A further problem that has been noted is that the demographic data for each of the study regions are based on the same population distribution, rendering all attempts to adjust for differences in age and sex between regions ineffective. The calculation of cancer rates based on these artificial population data can have negative effects on the evaluation of regional patterns of cancer. It is both possible and likely that the absence of census data has contributed to a dilution of regional differences in cancer rates for the study.

Assuming that Sumgayit had a younger population than the other regions over the study period, which is not unreasonable given its past industrial nature and past abundance of employment, cancer rates in Sumgayit could have been substantially underestimated. This could partially explain the only mildly elevated cancer rates witnessed in Sumgayit.

This study could not ascertain whether the population data supplied for the Sumgayit Cancer Study are also used by the government rather than actual census counts to

calculate disease rates for other or perhaps even all diseases. Should this be the case, estimates of regional disease burdens could be inaccurate (gross inaccuracies would prevail if, indeed, the actual demographic distributions of the populations differ to a significant extent). Not only could the relative burdens of disease among regions be inaccurately estimated, but the actual disease rates calculated throughout the country could be in error. Such errors could result in, among many other things, misallocation of health care resources, inaccurate disease surveillance, and erroneous assessment of the effectiveness of health care initiatives. Therefore, it is important that the Government of Azerbaijan, in particular the State Committee on Statistics and the Ministry of Health, address this methodological issue, should it be of relevance.

Capacity Building

Capacity building through direct cooperation between local and international researchers was necessary for the successful completion of this study. Local researchers provided the expertise necessary for obtaining, collecting, and interpreting local data, while international researchers offered expertise in the scientific method, and access to resources not available in the local setting. Unfortunately, the end goal of capacity building (the proposal and conduct of new research by local experts trained through this exercise) has not yet been achieved. Economic hardships continue to plague the country and make it difficult for researchers to independently propose and conduct research.

The capacity building component of the Sumgayit Cancer Study is still underway. One initiative, as part of the capacity building component of the Sumgayit Cancer Study, is the production of a textbook by the WHO describing the conduct of epidemiological research in a nation such as Azerbaijan. While the textbook will be directed primarily toward use in Azeri universities, the principles and methods described could be useful to a range of researchers and health professionals. Both a draft of the textbook, and the findings of the Sumgayit Cancer Study will be presented at interactive workshops in Azerbaijan during February 2003. These workshops are designed to impart knowledge

to, and stimulate thought in local experts with the hope that they will then propose and conduct independent epidemiological research.

Assistance and long-term commitment from the international development community will be necessary in developing human resources for epidemiological research. Investing in the training of young scientists to make them more competitive in the international arena (e.g., by establishing research and training projects in collaboration with leading academic institutions, providing the means to achieve financial security for those professionals engaged in research studies, and in further developing the capacity of local researchers to think strategically) would be invaluable to advancing a research agenda in the country. Encouragement and assistance provided by the Ministry of Health to these researchers, in the context of a broad strategic vision of the role to be performed by health research, will be of paramount importance in achieving these scientific and capacity-building goals.

Recommendations

Case-control studies may be the best method of evaluating cancer risk in the city of Sumgayit, and in Azerbaijan as a whole, for several reasons. Because case-control studies do not rely on pre-collected summary level health records nor demographic data, they are less likely to be adversely affected by problems of data quality and availability. A case-control study examining urinary bladder cancer could be the next step for cancer research in Sumgayit. Cancer of the urinary bladder has been implicated through this study as having the most elevated incidence of any of the selected cancers in Sumgayit, and given its known associations with occupational chemical exposures, it seems a suitable candidate for an occupational cancer case-control study.

Perhaps the best way to conduct future research in Azerbaijan, and other regions of the developing world would be through a similar model to this study, in which international donors and researchers team up with local experts and government agencies to investigate issues of both local and international importance. Given the current economic conditions

in Azerbaijan, it seems that any meaningful progress towards advancing cancer prevention and research programs, and health care in general, will remain largely dependent on continued funding and support from international donors.

Conclusions

The Sumgayit Cancer Study has addressed concerns that the city of Sumgayit is at greater risk of disease because of long-term occupational and environmental exposures.

Analyses of cancer incidence and mortality data for Sumgayit and selected other populations suggest that the residents of Sumgayit have elevated rates of urinary bladder, lung cancer, and all cancers combined relative to the rest of the country. While cancer rates are not elevated in selected international comparisons, this observation is most likely explained by issues with data quality and under-reporting of cancer in Azerbaijan.

In fact, a number of data quality issues have been identified that prevent strong conclusions being made by the study. The capacity building initiative will require additional investments by international donors and local government to further strengthen the ability of novice researchers to independently propose and conduct research.

Suggested future research in Sumgayit may include case-control studies on urinary bladder or lung cancers, or a detailed evaluation of cancer data quality.