Report

Investigation

of probable adverse health

effects from environmental

and other factors in the area

of Kato Lakatamia

COPY

Prepared for the
Ministry of Health in Cyprus

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Executive Summary

We were commissioned by the Ministry of Health of the Government of Cyprus to carry out a study of any adverse health effects from environmental and other factors in the area of Kato Lakatamia. The main problem for the research investigation is a perceived cancer cluster in Lakatamia. Following a number of site visits and several meeting with all the stakeholders as well as investigating all the sources of data the investigating team developed an agreed protocol for the study, which was broadly in line with the terms of reference set out by the Government. The components of the study included the following:

- Literature review.
- Census data for Lakatamia
- Analysis of routine data sources including mortality, cancer registrations and hospital admissions
- Assessment of social and medical perceived risk
- Rapid appraisal
- Analysis of dioxins and PCBs in human milk
- Assessment of electromagnetic fields
- Discussion conclusions and recommendations

1. REVIEW OF THE LITERATURE

The first point to emerge from our literature review is that perceived cancer clusters are extremely common. The second point is that clusters are a difficult problem for both politicians and public health specialists because of the real, genuine public anxiety that accompanies most reported clusters. And worldwide the number of reported cancer clusters has grown steadily over the last two decades, as the public has become more aware of cancer and the threat of growing number of environmental carcinogens.

There is no doubt that the growing public awareness of environmental hazards has led to an increase in the demand for public health authorities to investigate perceived cancer clusters. A cluster analysis may not be always effective in identifying the causes of disease but it often has to be done in order to address public concern about environmental health risks and issues.

Cancer is more common than most people realize. Cancer is the second leading cause of death in most industrial countries, following heart disease. About 30% of the population now living will eventually have cancer. Over the years, *cancer will strike about three out of four families*. Given these statistics, it is not surprising to know several people in an area or workplace who have cancer.

Many people believe that cancer is usually caused by exposure to toxic substances in the environment. We do not know the exact impact of environmental pollutants on

cancer development, but scientists estimate that fewer than 10%, *of cancer deaths are related to external environmental factors such as radiation and toxic chemicals etc*.

Scientists have identified certain circumstances that may lead them to suspect a potential common source or cause of cancer among people who are thought to be part of a cancer cluster. A suspected cancer cluster is more likely to be a true cluster, rather than a coincidence, if it involves:

1. A large number of cases of a specific type of cancer, rather than several different types;
2. A rare type of cancer, rather than common types; or
3. An increased number of cases of a certain type of cancer in an age group that is not usually affected by that type of cancer.

Before scientists can accurately assess a suspected cancer cluster, they must determine whether the type of cancer involved is a primary (original) cancer or a cancer that has spread from another organ (metastasis).

2. CENSUS DATA FOR LAKATAMIA

A number of the more common cancers, such as cancers of the lung and large bowel have a higher incidence in the more deprived section of the population. Indeed, with the exception of cancer of the breast, most cancers show a social gradient. Therefore, in an investigation of a cancer cluster it is essential to understand the social and economic factors at play in the area of the perceived cancer cluster.

The first point to emerge from our investigation of the census data is that the age structure of Lakatamia municipality is slightly younger than the national age structure. Nationally 21.1% of the population is aged 55 and over, compared to 14.2% in Lakatamia. Turning to the younger population, we see that nationally 48% are aged younger than 35 years compared to 55.6% in Lakatamia.

Within Lakatamia we note that the age structure of Ayios Mammas is substantially different from that of the other areas in the municipality in that it has fewer children and a much higher proportion of old people. Based on the age structure we would expect Ayios Mammas to have the highest incidence of age related cancers.
One of the strongest indicators of social deprivation is unemployment. From census data we have analysed the employment status of Lakatamia. The percentage is remarkably similar between all the areas, (which have just over 3% of the economically active population unemployed, with the exception of Ayios Mammas, which has over 8% unemployed).

We anticipate from a socio-economic perspective, that Lakatamia will have slightly more cancers than Lefkosia municipality, and that Ayios Mammas, in particular, will have a high incidence of cancer because of its age structure and social deprivation.

3. ANALYSIS OF ROUTINE DATA SOURCES

1) Mortality data

Data on death registrations in Cyprus were obtained from the Ministry of the Interior. The data were in the form of individual records for each death where the data of registration was in the period 2000-2004

For the analysis only those death registrations with complete and valid age, sex and 4-digit area of residence codes were included. There were 21,495 such registrations, representing 93.8% of the total 22,914 registrations recorded for the Government Controlled area of Cyprus during the period.

In the period 2000-2004 there were 492 death registrations of Lakatamia municipality residents. Indirect age standardised ratios (ISRs) suggest that all cause mortality in Lakatamia municipality (ISR=74.1, 95%CI: 67.7-80.9) was approximately 25% lower than both the Cyprus average and Lefkosia district average. Lakatamia also compares favourably against the other municipalities in and around Lefkosia city.

Within Lakatamia municipality there was a four-fold variation in all cause mortality between the quarters. Mortality in Archangelos - Anthoupolis was approximately 65% lower than the Cyprus average, whilst mortality in Ayios Mammas was 38% higher. Mortality in the index quarter of Ayia Paraskevi (ISR=88.9, 95%CI: 78.4-100.3) was not unusual and was lower than the Cyprus average.

Cancer mortality in Lefkosia district as a whole was observed to be approximately 30% higher than for Cyprus (ISR=128.5, 95%CI: 121.2-136.0). Rates were generally high in all of municipalities in and around Lefkosia with the exception of Geri, Anthoupolis Refugee Housing Estate and Lakatamia. Indirect ratios suggest that cancer mortality in Lakatamia municipality was approximately 15% lower than the Cyprus average (ISR=83.8, 95%CI:63.6-108.3).

Within the quarters of Lakatamia municipality the pattern for cancer mortality is similar to that observed for all cause mortality. Rates in Archangelos-Anthoupolis were low and rates in Ayios Mammas were high. Rates in the index quarter of Ayia Paraskevi were low.
Mortality data does not provide any evidence of there being an excess of cancer of deaths in Lakatamia municipality in general, and the main index quarter of Ayia Paraskevi in particular. The second index quarter, Ayios Mammas, has high but 'in-control' all-cause and all cancer mortality rates, which are probably associated with its unusual socio-economic characteristics.

2) Cancer registrations

Data on cancer registrations in Cyprus were obtained from the Ministry of Health. The registry collates histological confirmations of cancer diagnoses from hospital and histology centres in Cyprus, but does not routinely collate data from death registrations. The data were in the form of individual records for each cancer registration where the date of registration was in the period 1998-2002.

Information on the area of permanent residence is not routinely coded to the 6-digit quarter code. However, for Lakatamia residents only, the street address was used to manually allocate the records to the four quarters of Ayios, Mammas, Ayia Paraskevi, Archangelos-Anthoupolis and Ayios Nicolaos. This allocation was double-checked with the Mayor of Lakatamia's office.

Although the Lakatamia municipality cancer registration ratio is high compared to Cyprus, it is not unusually high when compared to the other municipalities in and around Lefkosia, falling approximately in the middle of the distribution. The overlapping confidence intervals suggest that the ratio is not statistically significantly different from that of any of the other municipalities listed.

The main index quarter of Ayia Paraskevi did **not** show unusually high levels of registrations for any of the specific cancers considered nor all cancers in general.

The secondary index quarter of Ayios Mammas has consistently high ratios for most of the specific cancers considered and all cancers in general. The ratio, however, never fell outside of the control limit of that expected. It should be remembered also that the control limits account only for random variation in the cancer registration ratio and do not include any further legitimate variation as a result of other factors such as deprivation. Ayios Mammas has particularly unusual socio-economic characteristics, being much more deprived than average, and may therefore be expected to have high ratios. It also has a particularly old age-structure, which may not be adjusted for sufficiently in the constructed of the age-standardise rates and ratios (it would be preferable to break the upper age band of 75+ into finer bands).

In conclusion the cancer registration data do **not** provide evidence of any unusual excess of cancer incidence that might be due to some special cause in the Ayia Paraskevi.

3) Hospital Admissions

Data on inpatient admissions to hospitals in Cyprus were obtained from the Ministry of Finance, Department of Statistics. The data were in the form of individual records for each inpatient admission where the data of discharge was in the period 1998-2002. For the analyses only those inpatient records with complete age, sex, diagnosis and 4-digit area of permanent residence data were used. There were 242,718 such records, representing 98.0% of the original 247,556 records in the data set.

The analyses of hospital admissions records have highlighted prostate cancer and cancer of the urinary tract as having potentially high levels in Lakatamia.

The observation for prostate cancer hospitalisation is consistent with that seen for prostate cancer registration. It should be noted, however, that for the registrations it was the quarters of Ayios Mammas and Ayios Nicolaos where the levels were high, not Ayia Paraskevi. Here it should be pointed out that prostate cancer is very age related in that it is largely a disease of older men.

The high level of hospitalisation for cancers of the urinary tract is NOT consistent with the unremarkable level of registrations for these cancers within Lakatamia. Of the two data sources the cancer registrations are considered to be a better proxy for the incidence of cancer than are the hospital inpatient records, for reasons related to the limitations of the data.

The most common urinary tract cancer is bladder cancer, a disease that requires frequent repeated follow-up cystoscopies. This means that a patient with bladder cancer is likely to require a number of hospital admissions. Variations in clinic practice, and variations in the frequency with which bladder cancers are followed up, are likely to have a significant impact on hospital admission rates, and this probably accounts for the high level found in Lakatamia.

A comparison of the number of hospital inpatient records to the number of cancer registrations for each of the cancer type shows that there are 4.5 times as many inpatient records for urinary tract cancer as there are registrations. This suggests that the hospital records include multiple admissions for the same individuals. The same ratio for Cyprus is much lower, 1.6. This provides evidence that the level of hospitalisation for urinary tract cancer in Lakatamia is artefactually inflated.

Overall therefore the hospital records do not provide any compelling evidence of the existence of an excess of level of cancer that might be attributable to a special source.

4. ASSESSMENT OF SOCIAL AND MEDICAL PERCIEVED RISK

In our literature review we saw that many perceived cancer cluster are just that; a perception in the mind of the local population that there are environmental risk factors that are causing an excess of cancers in the local population. However, the research shows that the perception of a cancer cluster is important to the local population, and a successful outcome to a cluster investigation can only be achieved if the concerns and worries of local people are taken seriously by the health authorities.

Recent developments in thinking about risk have resulted in an understanding that risk is a multifaceted concept with a number of different qualitative dimensions. These additional dimensions include psychological and socially influenced aspects, and political, economic and ethical characteristics.

On the basis of this approach to risk assessment, we decided that it was essential to ascertain the viewpoint of people living in the index area. After some discussions with local people, we concluded that the most appropriate method was a postal survey.

Having obtained approval from the commissioner for data protection we were advised that the respondent should give us permission to analyse their questionnaires by signing it. We were concerned that such an approach would be another factor that would reduce the response rate.

Most respondents described their general health as excellent or good (72.7%), 22.2% as fair and 4.3% as poor or very poor. However, there was a difference between men

and women, as shown in table 2. Women, it seems, tend to be more pessimistic about their health. While over a quarter of men (26.5%) describe their health as excellent, only 13.0% of women do.

The response rate was extremely disappointing, but perhaps not surprising. For people to respond to a postal questionnaire they need to feel strongly enough on the issue to take the time and trouble to complete the questionnaire. Yet, as we shall see from the rapid appraisal exercise, a large section of the population was unconcerned about the perceived cancer cluster. This lack of concern undoubtedly contributed to the low response rate. Also the fact that data protection required residents to sign the questionnaire had materially reduced the response rate.

There is little doubt that those who did respond would have more interest in the issue than the large number of non-responders. It is reasonable to assume that those who felt strongly on the issue were far more likely to respond. Therefore, there is a response bias that should be taken into account in interpreting the results. In general women tend to be more pessimistic about health risk. There is a high degree of concern about the apparent health risk of electromagnetic fields. Many people still believe that asbestos water pipes pose a health risk.

5. RAPID APPRAISAL

During the period between January and April 2005 we conducted a rapid appraisal exercise within the index area. Rapid appraisal is a useful technique to supplement the findings of the medico-social survey. The idea is to ascertain the views and opinions of local people who have first hand knowledge of the social and health problems of their own local community.

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Following a review of the index area, we divided it into six sections for the purpose of the rapid appraisal exercise. Interviews were carried out in each area. It is clear that there is a considerable difference in opinion between the six areas. The highest level of concern about cancers is in a triangle around Ayia Paraskevi, where people spend a lot of time talking to each other about their concerns about cancer.

The most widespread theory was that the main cause of cancer in the area is the asbestos pipes, which carries water to the houses. This was mentioned almost everywhere we went, although some people were sceptical. However, a number had stopped drinking tap water because of the cancer scare.

Traffic and environmental pollution were mentioned as other possible causes of cancers. One lady mentioned the mobile phone mast as a cause. No unexpected environmental factors were mentioned.

6. ANALYSIS OF DIOXINS AND PCBs IN HUMAN MILK

We collected 10 samples of human breast milk from volunteer mothers who are breast-feeding. Seven of the ten mothers were breast-feeding their first child and the other three their second child. All mothers selected to provide samples of breast-feeding milk have had a normal physiological delivery and have lived in the area for longer than the required minimum of the preceding six months. Participating mothers were asked to complete a standard WHO questionnaire and provided their written consent before they are selected to provide bread milk samples.

Analysis of the breast milk was conducted using HRGC/HRMS according to methods based on US EPA 1613. QA/QC procedures are conducted throughout the analysis using isotope dilution techniques to monitor recovery and enable qualification. If recoveries fall outside the acceptable range, analysis was repeated.

The average age of participating mothers was 27 years; the average weight of the babies was 3040 grams; average height 163 cms; average weight 71.9 kilograms.

The pooled average total dioxins (6.2 WHO TEQs) found in a sample of ten mothers resident within Lakatamia are lower than the levels reported in the EU and Australian studies.

There is no evidence of a significant environmental exposure to dioxins in Lakatamia.

7. ELECTROMAGNETIC FIELD MEASUREMENTS

The electromagnetic field measurements are displayed in appendix 3 and were found to be within normal limits.

8. CONCLUSIONS

1. We conclude that there is no evidence of an excess of cancers within Ayia Paraskevi. In particular, there is no evidence of an epidemic of bowel cancer in the index area. It is now important for these conclusions to be carefully discussed with local residents. A successful outcome to this study is not only to show that there is no excess of cancer, but also to convince the local population of this fact. This medical research study provided convincing medical evidence to persuade even the most distrustful people.

2. We conclude that there is an excess of cancers in the area of Ayios Mammas, which is most probably related to the socio-economic profile of the area. There is no evidence that the excess cancers are due to environmental factors. Attention should be directed to improving the health status of the area.

7. RECOMMENDATIONS

1. The findings of this complex study should be carefully communicated to politicians, important opinion formers, the press and the local population.

2. There should be a programme to improve the health and socio-economic status of residents within Ayios Mammas.

3. Attention should be given to improving still further the routine sources of data that are the lifeblood of research.

Section 1

Background to the study

1. INTRODUCTION

The Ministry of Health of the Government of Cyprus commissioned a group of consultants to work in collaboration with the Institute of Cancer Research (UK), to investigate the possibilities of any adverse health effects on the residents in the Municipality of Kato Lakatamia.

There is a long history of claims by residents of Ayia Paraskevi that there have been an excess of cancers, and particular cancers of the large bowel, with a widespread belief among the local population that these cancers have been caused by asbestos water pipes. Local residents in Ayia Paraskevi, in response to the perceived cancer cluster, have formed a committee with the name *Agonas*. The president of the committee, Mr Christakis Poumos, has been campaigning for a major environmental study to be carried out in order to try and find the true cause of the excess in cancers. Mr Poumos has been conducting a campaign mainly through letters to the press and interviews with national newspapers.

2. HISTORICAL BACKGROUND TO THE STUDY

In order to understand the nature of the problem we have analysed newspaper reports and documentation provided by the Ministry of Health and the Mayor's Office of the Municipality of Lakatamia. The historical sequence of events is set out below.

2.1 Events during the year 1997

As far as we were able to ascertain the campaign for an investigation into a cancer cluster started in September 1997 with an article in the newspaper *Filelefttheros* (2nd September 1997) claiming that there was a cancer epidemic in Ayia Paraskevi.

According to this newspaper article eleven residents from Ayia Paraskevi in Lakatamia within a distance of 88 square metres had been found to have cancer of the bowel, and as many had suffered from similar problems in the last 2 years. The informant (Mr Poumos) invited the Health Services at the Ministry of Health to investigate this issue and stated that he believed the root of the problem lay in the asbestos water pipes.

In his letter to the newspaper, Mr Poumos claimed that there were too many cancers of the large bowel and that the local doctors, the Municipality of Lakatamia and the responsible authority at the Ministry of Health were not really interested in finding the cause.

Also, the local residents committee *Agonas*, through its chairman Mr Poumos, issued the following statement:

> We insist that there is an epidemic of cancer in the area of Ayia Paraskevi in Kato Lakatamia and that in the last 18 months 14 people died from cancer and 9 of those died from cancer of the bowel. An additional 10 people have been diagnosed and are suffering from other forms of cancer.

On 5 September *Filelefttheros* published the names of people who had died from cancer, including those who had died from cancer of the large bowel. In summary, the newspaper article claimed that there had been 14 deaths from cancer, nine of which were from cancer of the large bowel.

2.2 Events during the year 2000

On 10 July 2000 *Filelefttheros* published an article after a visit to the area of Ayia Paraskevi, where the newspapers reporters walked the streets accompanied by Mr Poumos.

On 19 September 2000, following a public meeting in Lakatamia, the Mayor of Lakatamia, Mr Christos Violaris, wrote to the Minister of Health, Mr Frixos Savvides, requesting a medical research study to allay the fears of the community.

On 7 November 2000 the Ministry of Health started an investigation into the perceived cancer cluster in Lakatamia. The Minister of Health gave instruction to investigate the data, and when these had been confirmed and validated he would ask for a medical research study to be carried out. According to data provided by the committee of residents, *Agonas*, 42 residents from Lakatamia had died from cancer during the last five years and another 22 were suffering from the disease and are fighting for their lives. The suspected causal factors included asbestos water pipes, environmental pollution and traffic pollution.

On 10 November 2000 the Minister of Health issued a statement that a study into the alleged cancer incidents in Lakatamia was imperative for two reasons. First, to confirm the validity of the alleged cluster and, second, a scientific evaluation must be done for psychological reasons.

2.3 Events during the year 2003

On 30 March the Mayor or Lakatamia sought a meeting with Mrs D Akkelidou, Minister of Health, to discuss the issue of cancers in Lakatamia.

On 14 April 2003 the Ministry of Health wrote to the Mayor to confirm that the Health the Ministry would carry out a study to investigate the frequency of cancer incidents in comparison to other areas in Cyprus.

On 14 August 2003 the authorisation was given for a medical research study of the cancer incidents in Lakatamia. Dr Andreas Georgiou explained that the study would include a detailed investigation of all cancer incidents, and in parallel they would investigate environmental factors that might possibly contribute to an increase in cancer incidents.

On 19 November 2003 representatives of the local residents, accompanied by Green Party MP Mr George Perdikes, and the co-ordinator of the Health Committee, Ioanna Panayiotou, met the Minister of Health, Mrs Dina Akkelidou, to discuss the increased incidents of cancer in Lakatamia. The Minister committed herself to the commencement of a full medical research study to investigate the perceived cancer cluster in the area. Mr Perdikes noted that this is a very serious health problem and added that the residents had been seeking a solution to the problem for the last five years, but the previous government had not take any action.

2.4 Events during the year 2004

On 4 February 2004 the press published a statement that within the next few days the Ministry of Health would publish the tender documentation and appoint experts to carry out the medical research study into the cancer incidents in Lakatamia. On 6 June 2004 the Ministry of Health announced that they had appointed experts to carry out a full medical research study. The study will take about a year to complete and will investigate if the number of cancer incidents in the Lakatamia area is higher in comparison to other areas in Cyprus.

Comments.

1. The above account is the classic scenario of a perceived cancer cluster; where there is considerable concern among a section of the population about what they believe is an increased incidence of cancer. An essential task of a cluster investigation is to allay the fears and anxieties of the local population.
2. As with most cancer cluster investigations, there is a lack of trust between those who are perceived as Government officials and those who believe that their health is at risk. A cluster investigation must overcome this suspicion, and show that it understands local concerns.
3. It is clear that the media play an important role in creating or allaying public concern. Those in the media must accept that they have an obligation to avoid over sensationalizing a perceived cancer scare.
4. It is not enough to simply examine the cancer statistics in isolation, as the general public is unlikely to be convinced. Any investigation of a perceived cluster must understand and work with the concerns of the local people.

Our study of the background and history of events going back to 1997 was of considerable help as we set about designing the study.

Section 2

Designing the Study

The first stage of our investigation was to design an agreed study protocol with the Ministry of Health. This involved a detailed search of the literature, which is presented in section 3. We had a number of meetings with Dr Andreas Georgiou and Professor Julian Peto, a world authority on cancer epidemiology. Working within the terms of reference of the study we developed a protocol that was agreed by the Ministry of Health. It was agreed that the study should focus on ascertaining whether or not there is a cancer cluster in the area. Mortality data, cancer registry data, hospital activity data and population statistic from the census will be used to make appropriate geographical comparisons between Lakatamia and other areas in the Nicosia District.

1. THE INVESTIGATING TEAM

Dr Ted Williams, Consultant in Public Health Medicine and Occupational Medicine, and former lecturer in epidemiology at St George's Hospital Medical School, London, and Dr Andreas Georgiou, Chief Medical Officer, Consultant in Community Medicine & Hygiene, Occupational Medicine and General Medicine, of the Department of Medical and Public Health Services of the Ministry of Health of the Government of Cyprus, headed the investigating team. Mr Andy Leonidou Consultant in Human Resource Management was responsible for co-ordinating the study. Mr Daniel Eayres Medical Statistician had specific responsibility for analysing all the sources of data including Census data, mortality and data provided by the Cancer Registry as well as hospital activity data provided by the Department of Statistics. The investigating team included a Data Manager and other supporting Specialist Registrars in Public Health as well a Toxicologists, Dioxins Analysts, Medical Physicist and Electromagnetic Field Engineers.

The investigating team had access to continuing advice and support from Professor Julian Peto of the Institute of Cancer Research (UK) as well as access to other resources as and when they were needed. Professor Peto is well known as an international expert in cancer epidemiology and has published over 150 research papers on various aspects of cancer epidemiology.

The terms of reference of the study included reviewing the literature on cancer clusters and how this relates to the area of Kato Lakatamia and examining the various sources of data in detail. Amongst other issues the team undertook to investigate and evaluate medical records that exist in hospitals, clinics, out patient departments, the Central Offices of the Ministry of Health as well as all available records at the Department of Statistics of the Ministry of Finance such as the Census and Demographic Reports. The investigating team also obtained mortality records from the Ministry of the Interior for the last five years and all available records from the Cancer Registry.

The study set out to examine the differences in mortality between the local population and national figures, and carry out a comparative study of the health status using medical social questionnaires. The study would also examine hospital activity data and compare the morbidity of Kato Lakatamia in relation to other areas of Cyprus.

Dr Williams worked closely with Dr Andreas Georgiou, Chief Medical Officer in the Ministry of Health and Consultant in Community Medicine & Hygiene, Occupational Medicine and General Medicine, in designing the study. It was agreed that local factors should be taken into account in order to be sure that the study addressed the questions that were being investigated. Advanced medical research entails flexibility; therefore the objectives of the study were refined and developed according to the findings aiming at the disclosure of any public health problem.

2. SITE VISITS TO MEET STAKEHOLDERS

The first stage of the investigation was to make a number of site visits to meet all the stakeholders, which would help the investigating team understand the problem in more detail, and so design a more detailed protocol of the study, with the assistance of Dr A. Georgiou.

The team of research investigators visited Cyprus on a number of occasions for this purpose. The main aim of these visits was to gather as much information as possible about potential health problems before designing the study in more detail. We also examined all the sources of available data. Discussions were held with a wide range of stakeholders, including members of the Ministry of Health, The Mayor of Lakatamia and other officials from the Municipality, as well as representative from the local community and some of the residents, including those who have suffered with cancer.

2.1 Meeting with the Mayor of Lakatamia

We held several meetings with Mr Christakis Violaris, Mayor of Lakatamia, as well as other members of the Council. We explained the terms of reference of the study and sought support for study. We also gathered background information on the health concerns of the local community.

We explained that we would focus on finding out whether there was a cancer cluster in the area of Kato Lakatamia. We also explained that the terms of reference for the study included collection of human milk from breast-feeding mothers who recently had their first child. The milk would be frozen and sent to a special Laboratory in the UK for analysis of dioxins and PCBs. Special container for the milk collection would be provided for the mothers and a member of the research team would meet the mothers individually and explain all the necessary details.

The study would also include measurements of electromagnetic fields in a selection of estates. We discussed the methodology for selecting 20 houses for these

measurements and sought help in identifying volunteers in the area who would agree to have measurements taken in their house.
The Mayor was extremely helpful and supportive to this medical research study and offered us the full co-operation of the Office of the Municipality. In the end he was able to help us find the 20 houses we needed for the electromagnetic field measurement and allocated a member of his staff to drive around and introduce the consultants carrying out the measurements to the residents individually.

We also explained that we wanted to secure help and support for the distribution and collection of questionnaires relating to medical and social issues. We needed to obtain records from the local priest and were allowed to examine the death and burial records that were kept and match those to other sources of mortality data, such as those collected from the Ministry of the Interior. The Mayor offered and managed to obtain all the priests records on our behalf.

2.2 Meeting with the local committee *Agonas*

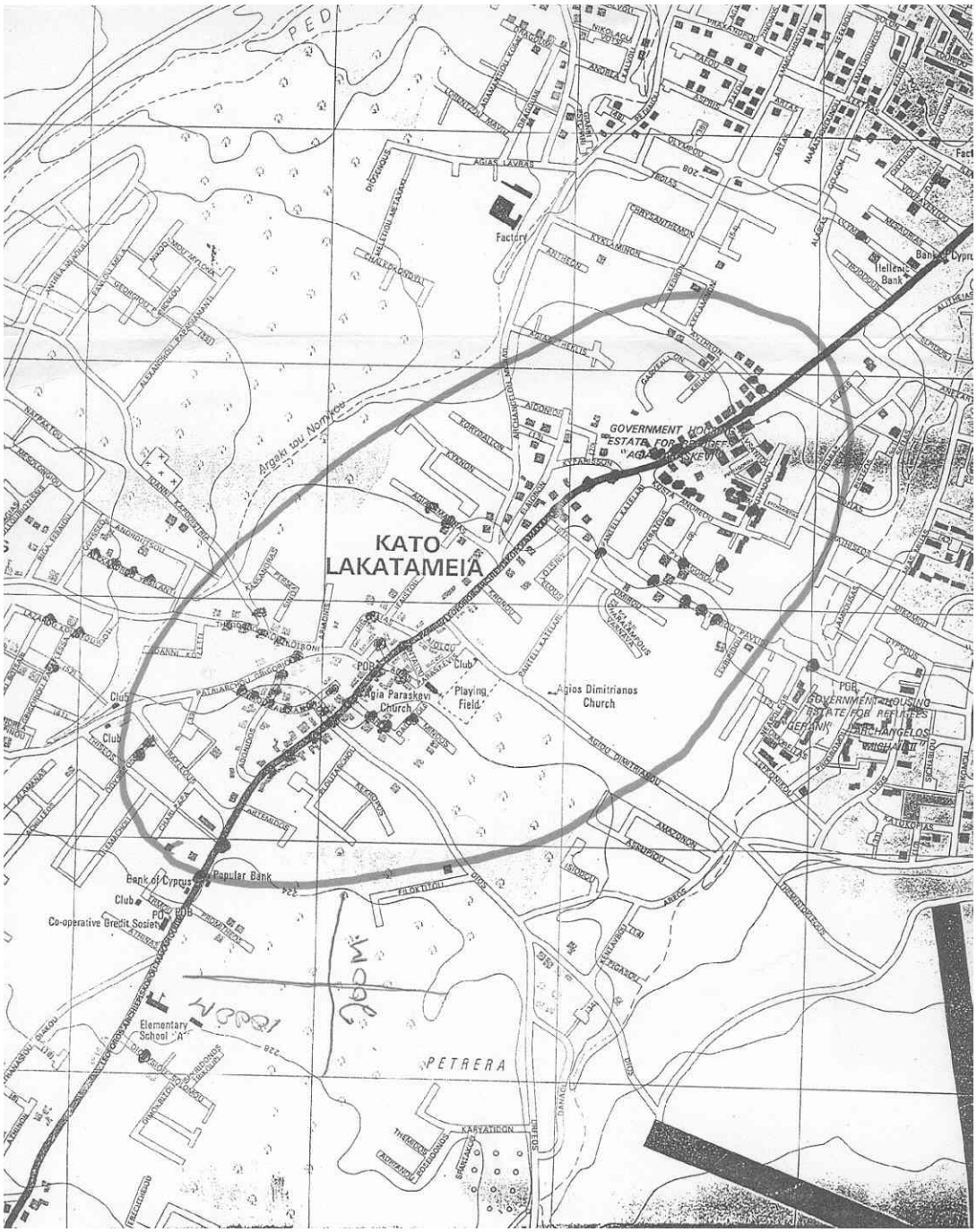
We met with members of the local committee to hear their concerns. We explained the terms of reference of the study to the committee and they were happy to offer us their full support and co-operation. Following initial discussion with committee members we had several meetings with the President of the committee Mr Christakis Poumos. Mr Poumos described his struggle to convince the authorities to commission full medical research study to get to the bottom of the problem and he was pleased that this was now happening. Mr Poumos provided us with several documents concerning the number of cancers in the area going back to 1997 and volunteered to take us round to some of the houses and introduce us to surviving cancer sufferers. We accepted this offer and walked around the area of Ayia Paraskevi with Mr. Poumos and indeed he did introduce us to people who had suffered with cancer. We were able to talk to them and hear their story.

2.3 Interview with Mr Poumos, president of local residents committee

We met with Mr Poumos in his house for an in depth interview. He described how the problem with cancer started in 1997 and the many attempts by the committee of local resident to persuade the authorities to have a proper medical research study carried out. They had been unsuccessful until now. Mr Poumos gave us a map of Kato Lakatamia with the area affected by cancers circled in red. This map is shown on the next page.

Mr. Poumos gave us copies of records he had been keeping. He said that during the period from 1996 to 2000 there had been 67 people who had been diagnosed with cancer. From those 67 people, 36 have already died and 31 are still alive. From 1996 to 31st March 2005, he claimed that there had been 128 people diagnosed with cancer, of whom 89 had died leaving 39 who are still alive. He said the total population in the area affected is 500-550 residents. We thanked Mr Poumos for the information he provided, and promised to investigate the issues thoroughly. We explained to him all the various aspects and terms of reference of the study and he expressed full

confidence in our research team. He also promised his full co-operation and support and during the period of the study we met him several times to keep him fully informed of developments and progress with the research.



2.4 Meeting local residents

We met with local residents on a few occasions to hear their stories about cancer incidents and to explore any other health concerns they had. By far the biggest problem described by residents was related to issues about cancer incidents in their area published in newspaper reports and seen in television programmes. Most people seem to blame asbestos water pipes for these problems and when we asked why they

said this was the information that was passed on to them in some form or another by the media or hearsay from the coffee shops and the gatherings in the church. The local communities asked for assurances that they would be given information on the outcomes of our study and we indicated that we would work with officials from the Ministry of Health to ensure they receive feedback.

3. INVESTIGATING SOURCES OF DATA

The second stage of our study was to ascertain the sources of data that were available, and to establish a relationship with key professionals that would assist us by providing us with access to data. To this end we visited a number of key organizations. Our first action was to make a tour of the area where most of the alleged incidents of cancer had occurred. To gain an impression of the situation on the ground we did a tour of the local area around what Mr Poumos calls 'the triangle of deaths' to assess the area for ourselves.

3.1 Cancer Registry

We were given information on how the Cancer Registry was set up in Cyprus, how information is collected and how the whole system is managed. The conclusion from this meeting was that it would be possible to use Cancer Registry data that had been collected from year 1998 onwards. The Cancer Registry provided us with an electronic copy of their records from 1998 to 2002 having first obtained permission for the use of the data from the Commissioner of the Data Protection in Cyprus.

3.2 The Ministry of the Interior

We met with officials from the Ministry of the Interior to discuss the system for collecting and collating mortality records. We were given to understand that the system of reporting deaths, recording and collating the information has been refined and it is now much improved. Death records are now fully computerised in the Information Technology Department of the Ministry of the Interior and they provided us with an electronic copy of their records from year 2000 onwards having obtained approval from the Commissioner of Data Protection.

3.3 The Department of Statistics

We held several meetings with officials from the Department of Statistics, situated within the Ministry of Finance. Mrs Chappa and members of her Department were very helpful and provided us with an electronic copy of data from the last census, which was completed in October in 2001, as well as an electronic copy of patient records for the years from 1998 to 2002. They also gave us copies of various statistical reports that were available and copies of demographic reports for the purposes of our study. The Ministry of Health obtained approval from the Commissioner of the Data Protection before the patient records data could be released for research purposes.

3.7 Previous Ministry of Health studies

The Ministry of Health carried out previous studies and investigations of the cancer incidents, in September 1997 and January 2001 respectively, as this has been a long-standing issue with the local residents. We were given copies of the various reports and statistical analysis carried out previously and have taken those into account as part of our analysis of data sources.

4. AN AGREED PROTOCOL

With the information collected from several site visits and following detailed discussions with Dr Andreas Georgiou, we were able to produce an agreed protocol. Our initial assessment, following a review of the scientific literature, and an assessment of the environmental information, led us to conclude that the most important areas of investigation were as follows:

4.1 Literature review

An extensive literature review will be carried out primarily on issues relating to cancer clusters. The literature review will include identification of cancer clusters and their specific characteristics as well their interpretation and management.

4.2 Examination of Population Census of Kato Lakatamia

The population census in Kato Lakatamia will be examined in detail with the aim of identifying the educational, occupational and social status.

4.3 Focus on identification of a cancer cluster

We agreed to carry out an in depth analysis to identify if there is a cancer cluster in the index area. A cancer cluster is defined as a greater-than-expected number of cancer cases that occurs within a group of people in a geographic area over a period of time. Cancer cases are more likely to represent a cancer cluster if they involve (1) one type of cancer, (2) a rare type of cancer, or (3) a type of cancer in a group not usually affected by that cancer, such as a cancer in children that is normally seen in adults. However, cases of common cancers are those most often perceived and reported by the public as being part of a cancer cluster.

4.4 Assessment of mortality

To compare the overall death rate in the population of the index area of Kato Lakatamia against selected control areas, Nicosia district and Cyprus. National age specific death rates will be calculated in order to calculate SMRs in the index and control areas.

4.5 Examination of hospital records

Using hospital data we planned to identify all admissions for cancer treatment and compare the admission rates of the index area to control areas, Nicosia District and the whole of Cyprus where possible. Depending on the quality of the data we plan to calculate age standardised admission ratios and indirectly age standardised proportional admission ratios in order to make geographical comparisons.

4.6 Medical social survey

By undertaking a questionnaire survey and doing a rapid appraisal exercise, we will estimate the perceived health risk to the population. It is now widely recognised that perceived social and psychological risks are important components of any environmental health risk assessment.

4.7 Rapid appraisal

We will supplement the medical and social survey with a rapid appraisal exercise that will capture the views and opinions of the local population and identify more precisely their concerns. The research team will identify various themes and make comparisons of views and opinions between the different geographical areas within Kato Lakatamia

4.8 Collection of human breast milk

We propose to collect 10 samples of human breast milk from volunteer mothers who are breast-feeding and send them to our specialist laboratories for analysis of dioxins and PCBs. Mothers selected to provide samples of breast milk must have had a normal delivery and lived in the area for at least six months.

4.9 Measurements of electromagnetic fields in a selection of estates

We have made special arrangements with TÜV Product Service Ltd who specialise in electromagnetic field measurements to send specialist specialists EMC engineers to Cyprus to carry out the electromagnetic field survey.

We agreed that H-field and E-field measurements would be made in 20 houses. The selection of the 20 houses will be made on the basis of a stratified selection sample to cover the whole area of Lakatamia. The sampling frame will include houses that are near electric pylons and also houses where there had been incidents of cancer. Historical information of previous reported incidents of electromagnetic radiation will be considered. In addition, geographical and topographical information will be considered when determining measurement locations.

For each house measurements will be made at pre-determined points/rooms within the house. Ambient measurements may also be taken outside each house. For each house, measurements may be made with all electrical power isolated from the house and with all electrical appliances switched on and powered-up. These *two* measurements will only be made if it is felt necessary and time permits.

4.10 Study objectives

1. To ascertain whether or not there is an excess of cancers in the index area compared to other areas in Nicosia district.

2. To reassure the local population, pressure groups and politicians that the perceived cancer cluster has been thoroughly and professionally examined.

3. In the event that there is an excess of cancers, to advise the authorities regarding the need for further research studies to identify causal factors. In the event that there is no excess of cancers, to reassure the public so that the fears and concerns of the perceived epidemic should be finally put to rest.

Section 3

Literature review of cancer clusters

1. INTRODUCTION

The aim of this review is to provide a background to our investigation of the perceived cancer cluster is Lakatamia. We believe that an examination of the literature will help to place this investigation into the right perspective. The first point to emerge is that perceived clusters are extremely common. The second point is that clusters are a difficult problem for both politicians and public health specialists because of the real, genuine public anxiety that accompanies most reported clusters. And worldwide the number of reported cancer clusters has grown steadily over the last two decades, as the public has become more aware of cancer and the threat of growing number of environmental carcinogens.

1.1 A common problem

There is no doubt that the growing public awareness of environmental hazards has led to an increase in the demand for public health authorities to investigate perceived cancer clusters. And there is no doubt that the investigation of clusters poses considerable problems for public health authorities, as has been the case in the perceived cluster in Lakatamia. This is also the case in the USA, where there has been considerable public concern about cancers clusters, as highlighted by the film Erin Brockovich, which dramatises the story of a cancer cluster caused by environmental pollution from a nearby chemical factory.

2. CLUSTER INVESTIGATION BY CENTRES FOR DISEASES CONTROL

A survey of all 50 states within the USA, conducted in 1989, showed that around 1,500 requests for cancer cluster investigations were received by state health departments. Most states responded with a three-stage process aimed at prioritising clusters at each stage. Those situations deemed most serious were passed on to the next stage of evaluation. Thirty-eight of the 50 states said that communicating risk information to informants was a productive outcome, and 26 states sent materials to informants explaining the causes of cancer, clusters, how clusters are investigated, and other health education materials. Many states requested detailed information about reported clusters from informants.

The authors of the survey recommended that health departments train their respondents in risk communications and establish an organizational climate that provided financial resources and institutional support appropriate to the complex task of communicating risk information to a public alarmed about a cancer cluster.[1]

The greatest amount of research into clusters has taken place in the USA and the Centres for Disease Control and the National Cancer Institute are now the world leaders in cluster research. As experience of investigating clusters has grown, so the

approach has changed. On the basis of its experience, in 1990 CDC issued guidelines for the investigation of clusters, and in 2003 held a two of workshops from health departments from the various States to shared experiences on how the guidelines were working.

In this review we first review the CDC guidelines, then we give the latest thinking in cluster investigation, before examining a number of research papers.

2.1 CDC Guidelines for investigating clusters

In 1990 the Centres for Disease Control issued guidelines for the investigation of clusters of health events in the USA.

From a public health perspective, the *perception* of a cluster in a community may be as important as, or more important than, an actual cluster. In dealing with cluster reports, the general public is not likely to be satisfied with complex epidemiological or statistical arguments that deny the existence or importance of a cluster. *Achieving rapport with a concerned community is critical to a satisfactory outcome*, and this rapport often depends on a mutual understanding of the limitations and strengths of available methods.

CDC guidelines recognise that the investigation of a perceived cluster of adverse health effects is not simply an isolated epidemiological or statistical exercise. Appropriate response by public health agencies to requests for such investigations demands that the complexity of this area be recognized and, in addition, requires the possession and application of skills and knowledge that extend well beyond statistical and epidemiological tools. These additional skills include sensitivity to the psychology of the situation, an understanding of the principles of risk perception, recognition of the functions of public media, and an awareness of potential legal ramifications of the investigation.

CDC guidelines warn of a number of problems that are encountered in the study of clusters. The health events being investigated (often morbidity or mortality) are usually rare, and increases of these events tend to be small and may occur over a long period. Another issue that complicates the investigation is that some clusters occur by chance. Information on the population at risk or on the expected rates often is not available. A further complicating factor for methods using aggregated data is that health events occur in space and time continua, thus yielding optional and sub optimal units for displaying a pattern. The choice of a geographic area that is too small or too large, or of a time period that is too short or too long, may result in insufficient statistical power to indicate a cluster.

3. DEFINING A CLUSTER

A cancer cluster is defined as an unusual number of cancers occurring during a specific time period among people who live or work together. The impression that a cancer cluster exists usually begins when someone's spouse, neighbour, or friend is

diagnosed with cancer. It is not uncommon for people to suspect the cancer cause is a chemical in the environment. Increased awareness about cancer and the search for a cancer cause may lead someone to contact the public health authorities. The following cancer facts need to be understood in order to see a perceived cancer cluster in perspective.

3.1 Cancer is a common disease

Cancer is more common than most people realize. Cancer is the second leading cause of death in most industrial countries, following heart disease. About 30% of the population now living will eventually have cancer. Over the years, *cancer will strike about three out of four families*. Given these statistics, it is not surprising to know several people in an area or workplace who have cancer.

3.2 Cancer is not one disease

Cancer is a group of more than 100 diseases characterized by uncontrolled growth and spread of abnormal cells. Different types of cancer have different causes, different rates of occurrence, and different chances for survival. What turns a breast cell into breast cancer isn't what turns a white blood cell into leukaemia. Therefore, we cannot assume all the different types of cancer in a community share a common cause.

In addition, even if the cancers seem to be similar, they may not have a similar cause. Cells have a variety of genes that keep them functioning normally and it takes a combination of factors - what cancer biologists call multiple 'hits'- to make a cell cancerous. One combination may be a genetic defect combined with an exposure to a cancer-causing agent (also called a 'carcinogen'). Another combination may be a lifestyle factor such as smoking combined with a specific viral infection. To further complicate matters, each of these factors can be modified by individual characteristics that are poorly understood. Thus, it is possible that the cases of a certain cancer in a cluster may have causes that are unrelated to each other.

3.3 Cancer is age related

The risk of having cancer increases with age. While cancer occurs in people of all ages, cancer rates rise sharply among people over 45 years of age. When a community consists primarily of people over the age of 45, we would expect more cancer than in a more mixed area. We would expect even more cancer if most people were over the age of 60.

3.4 Many causes of cancer

While the exact cause of most cancers is unknown, cancer may be caused by a variety of factors acting alone or together over many years. Scientists estimate that most cancers are associated with factors related to lifestyle, cigarette smoking, heavey drinking, lack of regular physical exercise, promiscuous sexual behavior, sunlight exposure etc. A family history of cancer increases a person's chances of developing some cancers. Environmental and occupational exposure to some chemicals and

agents increases the risk of cancer as well. Nevertheless, the reaction of people to environmentally related cancer risk is the most prominent. This is due to the fact that their exposure to environmental pollution is beyond their will or control and it is provoked by other people's activities. We do not know the exact impact of environmental pollutants on cancer development, but scientists estimate that fewer than 10%, *are related to external environmental factors such as radiation toxic chemicals etc*.

Cancers today are usually related to events that happened many years ago. Cancer does not develop immediately after contact with a carcinogen. Instead, there is often a long period, 15 to 30 years, between the exposure to a carcinogen and medical diagnosis of cancer. This makes it very difficult to track what caused the cancer. The cancers we see now are usually related to a lifetime of certain habits or exposure to a carcinogen many years ago. And, in a mobile society like ours, cancer victims who seem to be clustered may not all have lived in an area long enough for their cancers to be caused by exposure to a carcinogen in the community environment.

3.5 Clusters may be due to random variation

Cancer clusters may occur by chance. Even if there are more people with one type of cancer in a community than might be expected, we cannot assume it was caused by exposure to a cancer-causing agent in the environment. The cluster may have occurred simply by chance.

There are several principles to keep in mind when investigating a cluster of cancer: People have a tendency to see patterns in random events. For example, in a coin toss, people assume that a sequence of 6 'heads' in a row is somehow less random than 'head-tail-head-head-tail-tail'. But in reality, both sequences are equally likely.

People tend to isolate a cluster from its context. This is known as the 'Texas Sharpshooter Fallacy'. The Texas sharpshooter shoots at the side of a barn and then draws a bull's-eye around the bullet holes. In the same way, we might notice a number of cancer cases, then draw our population base around the smallest area possible, neglecting to remember that the cancer cases actually came from a much larger population.

To decide whether the number of people with cancer in a reported cluster may be more than expected, scientists use data from national cancer registries to calculate an 'expected' number of cases. They then compare the 'expected' number of cases with the 'observed' number of cases by performing one or more statistical tests. In making statistical comparisons - usually at a '95% confidence level' - five of 100 comparisons may be significantly different by chance alone.

A typical cancer registry tracks 80 different kinds of cancer. Using these facts, statisticians at the California Department of Health Services have calculated that there is a 98% chance that a given community will show a statistically significant but totally

random elevation in the rate of at least one type of cancer. Thus, even when a statistical test shows there is a 'statistically significant' difference between the observed and the expected number of cases, in many instances the significant difference is due to chance and not to a real hazard in the community.[2]

4. NATIONAL CANCER INSTITUTE OF THE USA

The National Institute provides the following information for those who are concerned about a perceived cancer clusters.

4.1 Identifying clusters

Reported disease clusters of any kind, including suspected cancer clusters, are investigated by scientists who use their knowledge of diseases, environmental science, lifestyle factors, and bio statistics to try to determine whether a suspected cluster represents a true excess of cancer cases. Scientists have identified certain circumstances that may lead them to suspect a potential common source or cause of cancer among people who are thought to be part of a cancer cluster. A suspected cancer cluster is more likely to be a true cluster, rather than a coincidence, if it involves:

1. A large number of cases of a specific type of cancer, rather than several different types;
2. A rare type of cancer, rather than common types; or
3. An increased number of cases of a certain type of cancer in an age group that is not usually affected by that type of cancer.

Before scientists can accurately assess a suspected cancer cluster, they must determine whether the type of cancer involved is a primary (original) cancer or a cancer that has spread from another organ (metastasis). This is important to know because scientists consider only the primary cancer when they investigate a possible cancer cluster. Scientists also try to establish whether the suspected exposure has the potential to cause the reported cancer, based on what is known about that cancer's likely causes and what is known about the cancer-causing potential of the exposure.

In addition, scientists must show that the number of cancer cases which have occurred is significantly greater than the expected number of cases, given the age, gender, and racial distribution of the group of people at risk of developing the disease. They must also determine if the cancer cases could have occurred by chance. Scientists often test for statistical significance, which is a measure of the likelihood that the observed association could simply have been due to chance. In common practice, a statistically significant finding means that there is a 5 percent or less chance that the observed number of cases could have happened by chance. For instance, if one examines the number of cancer cases in 100 neighbourhoods, and cancer cases are occurring randomly, one should expect to find about five neighbourhoods with statistically significant elevations. In other words, some amount of clustering within the same family or neighbourhood may occur simply by chance.

Another difficulty scientists face when investigating a possible cancer cluster is accurately defining the group of people who should be considered 'at risk'. One of the greatest pitfalls of defining clusters is the tendency to extend the geographic borders of the cluster to include additional cases of the suspected disease as they are discovered. The tendency to define the borders of a cluster on the basis of where known cases are located, rather than to first define the population and then determine if the number of cancers is excessive, creates many clusters that are not genuine. Scientists must also consider that a confirmed cancer cluster may not be the result of any single, external cause or hazard. A cancer cluster could be the result of chance, miscalculation of the expected number of cancer cases, or differences in the case definition (the criteria that determine whether or not the cases being investigated are related to the cluster) between observed cases and expected cases. Moreover, because people change residence from time to time, it can be difficult for scientists to identify previous exposures and find the records that are needed to determine the kind of cancer a person had—or if it was cancer at all.

Because a variety of factors often work together to create the appearance of a cluster where nothing abnormal is occurring, several reports of suspected cancer clusters are not shown to be true clusters. Several reported clusters do not include enough cases for scientists to arrive at any conclusions. Sometimes, even when a suspected cluster has enough cases for study, a greater than expected number of cases (a true statistical excess) cannot be demonstrated. Other times, scientists find a true excess of cases, but they cannot find an explanation for it. For example, a suspected carcinogen may cause cancer only under certain circumstances, making its impact difficult to detect.

5. GENETICS AND ENVIRONMENT

Because most cancers are likely to be caused by a combination of factors related to genetics and environment (including behaviour and lifestyle), studies of suspected cancer clusters usually focus on these two issues. However, establishing significant and valid evidence that a specific genetic factor leads to an increased chance that a specific environmental exposure will result in cancer (called a gene- environment interaction) requires studies of large populations over long periods of time. Researchers are just beginning to learn about the roles heredity and environmental exposures play in carcinogenesis. Some of their discoveries are outlined below:

5.1 Genetics

All cancers develop because of genetic alterations of one kind or another. An alteration is a change or mutation in the physical structure of a gene that interferes with the gene's normal functions. Some alterations that increase the risk of cancer are present at birth in the genes of all cells in the body, including reproductive cells. These alterations, which are called germline alterations, can be passed from parent to child. This type of alteration is known as an inherited susceptibility and is uncommon as a cause of cancer.

Most cancers are not due to an inherited susceptibility but result from genetic changes that occur during one's lifetime within the cells of a particular organ. These genetic changes are called somatic alterations. Familial cancer clusters (multiple cases among relatives) have been reported for many types of cancer. Because cancer is a common disease, it is not unusual for several cases to occur within a family. Familial cancer clusters are sometimes linked to inherited susceptibility, but environmental factors and chance may also be involved. Having an inherited susceptibility for a type of cancer does not guarantee that the cancer will occur; it means there is an increased chance of developing cancer if other factors that promote the development of cancer are present or later develop.

5.2 Environment

The term *environment* includes not only air, water, and soil, but also substances and conditions in the home and workplace. It also includes diet; the use of tobacco, alcohol, or drugs; exposure to chemicals; and exposure to sunlight and other forms of radiation.

People are exposed to a variety of environmental factors for varying lengths of time, and these factors interact in ways that are still not fully understood. Further, individuals have varying levels of susceptibility to these factors.

Because some workers may have greater and more prolonged exposures to hazardous chemicals that are found widely at lower levels in the general environment, positive findings from studies in the workplace provide important leads regarding causes of cancer in other settings. In fact, occupational studies have identified many specific chemical carcinogens and have provided direction for prevention activities to reduce or eliminate cancer-causing exposures in the workplace and elsewhere.

6. REPORTING SUSPECTED CANCER CLUSTERS

Concerned individuals may report a suspected cancer cluster to their local health department. When a suspected cancer cluster is first reported, the health department gathers information about the suspected cluster and gives the inquirer general information about cancer clusters. Although health departments may use different processes, most follow a basic procedure in which increasingly specific information is obtained and analysed in stages. Health departments are likely to request the following:

1. Information about the potential cluster: type(s) of cancer, number of cases, suspected exposure(s), and suspected geographic area/time period.
2. Information about each person with cancer in the potential cluster: name, address, telephone number, gender, race, age, occupation(s), and area(s) lived in/length of time.
3. Information about each case of cancer: type of cancer, date of diagnosis, age at diagnosis, possible causes, metastatic sites, and physician contact.
4. Worries about suspected cancer clusters might be resolved at this initial contact because concerned individuals realize that what seemed like a cancer cluster is

not a true cluster. If further evaluation is needed, the health department will take the steps to investigate a possible cancer cluster:

5. Attempt to verify the reported diagnoses by contacting patients and relatives and obtaining medical records.
6. Compare the number of cases in the suspected cancer cluster with information in census data and cancer registries.
7. Review the scientific literature to establish whether the reported cancer(s) has been linked to the suspected exposure.

6.1 CDC Workshops on Cancer Cluster Investigation-National Center for Environmental Health (NCEH)

In March 2003 the National Center for Environmental Health (NCEH) of the Centers for Disease Control and Prevention (CDC) sponsored two one-day workshops to provide a forum for dialogue between CDC and representatives from state health agencies. The workshops provided CDC with information to assist the States in cancer cluster inquiry response and investigation, and to assess capacity at the state and federal level. Workshop goals included the assessment of the States' needs to respond effectively to citizen inquiries about cancer clusters, the co-ordination of federal response to States' efforts, and the enhancement of the scientific process underlying cluster investigations. During the workshops, recommendations for further research and collaboration with state partners were discussed.

State attendees gave presentations describing their method of responding to citizen's inquiries about potential cancer clusters. The representatives also discussed the strengths and weaknesses of their States' responses, as well as the barriers to effective response. In addition, the representatives described prior experiences that were significant in shaping their current approach, and they discussed issues specific to their state. This report represents a summary of discussions from both workshops.

6.2 Current Procedures

Representatives from State Health Departments and health agencies presented information about their responses to cancer cluster inquiries. Despite differences in experience, policy, resources, and other issues noted by workshop participants, States have a great deal in common in the ways they respond to citizens concerned about suspected cancer clusters. For instance, the majority of States apply a systematic approach in responding to reports of cancer clusters, and most states make an effort to triage incoming calls to the appropriate people. In addition, States have developed and shaped their responses based on their own past experience and the experiences of other states with whom they share information. All the state representatives expressed interest in improving the science relevant to cancer cluster report and inquiry.

The state representatives reported that upon receiving an inquiry from a concerned citizen about a possible cancer cluster, States try to educate the caller about the issues involved in the study of cancer clusters with suspected environmental aetiology and with the complexities of the issues.

Workshop participants first noted a number of strengths in their response to citizens' inquiries. These strengths included state health department web sites, which provide information about cancer and suspected environmental causes of cancer. Some States have strong relationships with the public, press, governmental and non-governmental agencies.

A problem cited by several state representatives is the lack of trust by the public that state health departments adequately investigate reports of cancer clusters. Constituents may view state departments of health as 'government' and may be suspicious of state personnel if no cluster is acknowledged and no environmental link is found. In addition, the public has increasing access to media reports and films sensationalising instances in which environmental causes have been suggested. As a result, state representatives noted that some of their constituents might believe the government has something to hide, although the constituents have received all available information.

State representatives also mentioned the public's lack of knowledge about cancer and cancer aetiology. Workshop participants noted that the public, press, other state agencies, and politicians would benefit from education about cancer and scientific methods of investigating cancer clusters. State representatives noted the difficulty in adhering to decision criteria for cancer cluster investigations based on scientific rationale when the impetus for investigation was based primarily on meeting public demand.

7. OTHER RESEARCH

To facilitate explanations about the large random variation of small-area tumour incidence, the cancer registry in Germany developed a software simulation tool. Under the assumption of no cancer causes other than chance, the tool simulated a small village population with an average number of five inhabitants per house and allowed graphical visualisation of ten streets with 100 houses. Published age-specific incidence and mortality data were used for event sampling based on the binomial distribution. Program parameters included sample size, age distribution, cancer incidence, and mortality rates. The study showed, on average, that 22 percent (2.2/10) of all houses per street would have been inhabited by at least one cancer patient during the last five years in the simulated small village. The software tool can be used effectively for numerical and graphical visualisation of small-area tumour incidence and prevalence rates due to chance alone. The explanation of basic scientific concepts to members of the public can help to increase public motivation and support for population-based cancer registration. Our simulation tool can be used to support this goal.[3]

A study in North Wales investigated claims by a campaigning group of a cancer cluster associated with a local cement works. To investigate cancer rates in the town the researchers defined the study area as the Census wards matching the geographical area code supplied to the campaigning group. Standard methods were applied to registered cases of cancer for the area for the years 1974-1989 to derive observed and

expected numbers. The significance of the relative risk was assessed using the Poisson distribution. By selecting a different denominator population an attempt was made to reproduce the results of the campaign group. Cancer rates around the cement works were investigated for four cancer types plausibly associated with emissions, using cancer registrations for the years 1985-1994. Cases were mapped to 1981 Census ward boundaries, and the same statistical methods were used, but expected counts were also adjusted for deprivation. Rates were calculated for an inner 2 km zone and outer zone 2-5 km from the works. Relative risk was calculated and the ratio of risks was examined for evidence of increased risk closer to the works. The results of the study showed that relative risks were not significantly elevated either in the town or around the cement works itself. The researchers found no evidence of increased incidence of cancer around the cement works. Incorrect handling of cancer registration data can result in spurious cancer clusters and unnecessary public alarm.[4]

A paper by the Department of Epidemiology and Biostatistics of the University of South Carolina School of Medicine shows that the scientific investigations of cancer clusters rarely uncover new knowledge about the causes of cancer. However, a set of common characteristics, unique to etiologic cluster investigations have uncovered new information about the causes of cancer or demonstrated a preventable link to a known carcinogen. These characteristics may provide useful clues for sorting out the small number of clusters worthy of further scientific investigation. Public awareness of cancer clusters may promote an opportunity to inform and motivate people about the preventable causes of cancer and effective cancer screening methods.[5]

The Environmental Health Investigations Branch, California Department of Health Services, observed childhood ‘cancer clusters’ in small communities in central California. This prompted them to examine the distribution of childhood cancer in communities throughout the region to see if the overall cancer rate or the distribution of 'cancer clusters' was unusual for agricultural towns where pesticide exposure might be elevated. The distribution of rates was evaluated using a variety of methods: comparison of rates to the regional average, evaluation of the empirical observed versus expected Poisson distribution of events, and multivariate modelling using Poisson regression. These analyses suggest that there were no previously undiscovered communities with excess rates, although the index community, which prompted the initial investigation, did stand out as unusual. The paper discusses the impact of a range of forces of morbidity on the likelihood of cancer clusters and the distributions of observed and expected numbers of cancers in a population of locales.[6]

It is imperative to stress that the investigation of perceived cancer and leukaemia clusters, which (according to the public) are related to environmental health risks has been attained (in several studies) by the simultaneous examination of cluster and the probable causative environmental factors. In a recent publication in the BMJ[7] Gerard Draper et al examined childhood cancer in relation to distance from high voltage power lines in a case control study in England and Wales.

Also in the final report[8] of the expert panel on childhood leukaemia in Churchill County (Fallon), Nevada, the following procedure is described: "The first phase of the investigation commenced in September 2000 and involved interviewing each of the case families to determine where they had lived, how the water was supplied to those households, what sources of water were used for drinking and cooking, household chemical exposures, military history and family medical history. This information is used to learn if there are any common characteristics among all or most of the case families.

8. ASBESTOS IN THE WATER

In May 2002 the Foundation for Water Research in the UK published a detailed review of the health effects of asbestos fibres in the water supply. The executive summary of is presented:

'Although measurement of asbestos fibres in drinking water is technically difficult, research has indicated that most waters, whether or not distributed through asbestos cement pipes, contain asbestos fibres. This is because asbestos is widely found in the environment as a consequence of natural dissolution of asbestos-containing minerals. Asbestos cement pipes can give rise to an increase in the numbers of asbestos fibres in drinking water, particularly when first installed. The risks to health from ingestion of asbestos fibres in food and drinking water have been extensively studied by both epidemiology and by experiments in laboratory animals.

'Most epidemiological studies found no association with any specific gastrointestinal cancers, although a small number of studies did find a weak positive association. The studies considered the best did not provide evidence for a link between asbestos in drinking water and cancer. Of the 8 long-term animal studies, only one suggested a possible statistically significant increase in benign tumours in one sex, when compared to historical control animals but not the control animals used in the study.

'There is potential for exposure to asbestos fibres in drinking water by inhalation of aerosol droplets or from fibres that are trapped on clothing during washing and which are subsequently released into the atmosphere. This has been studied and except in an extreme case there was no measurable increase in the number of fibres in the indoor atmosphere of houses. In addition, the fibres in drinking water consist almost entirely of short fibres, which are considered to contribute little or no risk to public health.

'The World Health Organisation considered asbestos in drinking water arising from asbestos cement pipe in their 1993 edition of the Guidelines for Drinking Water Quality. The guidelines state:

> Although well studied, there has been little convincing evidence of the carcinogenicity of ingested asbestos in epidemiological studies of populations with drinking water supplies containing high concentrations of asbestos. Moreover in extensive studies in laboratory species, asbestos has not consistently

> increased the incidence of tumours of the gastrointestinal tract. There is therefore no consistent evidence that ingested asbestos is hazardous to health and thus it was concluded that there was no need to establish a health-based guideline value for asbestos in drinking water.

'Asbestos cement pipes have been widely used for drinking water distribution and there are many kilometres to be found all over the world. Although few countries still install asbestos cement pipe, primarily because of issues with handling, there appears to be no concern for health of consumers receiving the water and no programmes to specifically replace asbestos cement pipe for this reason.'[9]

It is therefore reasonable to conclude that there is no evidence that asbestos water pipes are associated with an increase of colorectal cancer. There is no evidence that asbestos water pipes have ever caused a cancer epidemic.

9. LESSONS FROM THE LITERATURE

1. Reporting cancer clusters is extremely common in many countries. Cancer is an extremely common chronic condition, and around a third of deaths have a cancer-related diagnosis. Over time, three out of four families will have experienced a cancer. On average, almost a quarter of all houses in a street would have been inhabited by at least one cancer patient during the last five years in an average small village. It is therefore essential for health authorities to have a well-worked out protocol for investigating perceived cluster.
2. Several reports of clusters, when examined are shown to be perceived clusters and there is no real excess of cancers above the range expected calculated from national figures.
3. The perception of the cluster must be taken seriously and properly investigated in order to allay public fears and concern.
4. It is essential for health authorities to work along side those who are concerned about the cluster, so that at the end of the investigation public concern is properly dealt with.
5. There is no evidence that asbestos water pipes have been associated with an epidemic of colorectal cancer.

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Section 4

Census data for Lakatamia

There is clear evidence that socio-economic status has a significant impact on the incidence of cancer. A number of the more common cancers, such as cancers of the lung and large bowel have a higher incidence in the more deprived section of the population. Indeed, with the exception of cancer of the breast, most cancers show a social gradient. Therefore, in an investigation of a cancer cluster it is essential to understand the social and economic factors at play in the area of the perceived cancer cluster. It is also essential to take account of the age structure of the population under investigation, as the incidences of the most cancers are strongly age related, and sometimes even standardising for age difference does not completely remove the age effect.

In this section we present data derived from the 2001 national census. We approached statisticians in the Department of Statistics who very kindly provided us with an abstract of data on economic activity and educational attainment down to a six digit geographical code. This allowed us to compare the areas within Lakatamia municipality for these variables.

1. AGE STRUCTURE

The national census of 2001 has been analysed to construct the age profile of the index area, as shown in table 1. In table 1 the population is grouped into six age bands, and in the figures presented over page the populations is grouped into 10-year age bands.

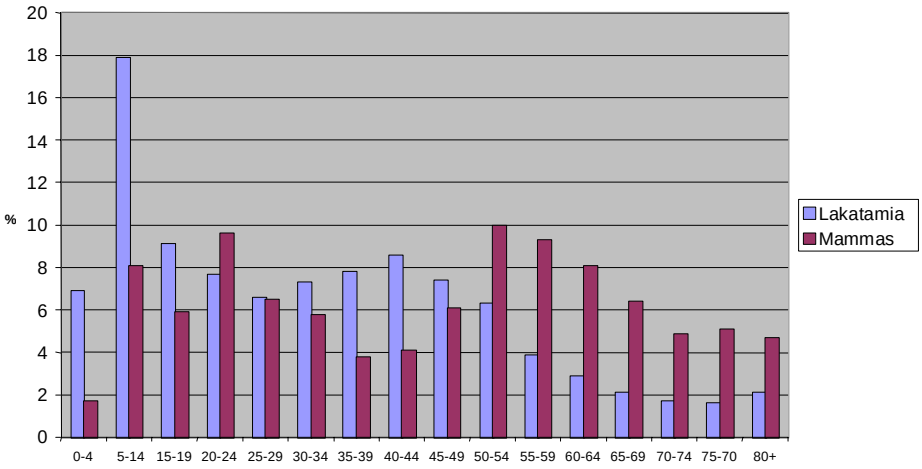
Table 1 **Age profile of Lakatamia municipality**

	Lakatamia	Mammas	Paraskevi	Anthoupolis	Nicolaos	Cyprus
Population	28,481	1,145	11,785	11,285	4,237	668,180
Age group			Percentage			
0-4	6.9	1.7	6.4	7.9	6.8	6.2
5-14	17.9	8.1	17.3	20.0	17.2	15.2
15-34	30.7	27.7	30.2	31.0	32.4	29.5
35-54	30.0	23.9	30.0	30.7	30.3	27.9
55-74	10.6	28.7	12.2	7.4	10.0	16.2
75 and over	3.8	9.8	4.0	3.1	3.3	4.9
	100	100	100	100	100	100

This first point to note is that the age structure of Lakatamia municipality is slightly younger than the national age structure. Nationally 21.1% of the population is aged 55 and over, compared to 14.2% in Lakatamia. Turning to the younger population, we see that nationally 48% are aged younger than 35 years compared to 55.6% in Lakatamia.

Within Lakatamia we note that the age structure of Ayios Mammas is substantially different from that of the other areas in the municipality in that it has fewer children and a

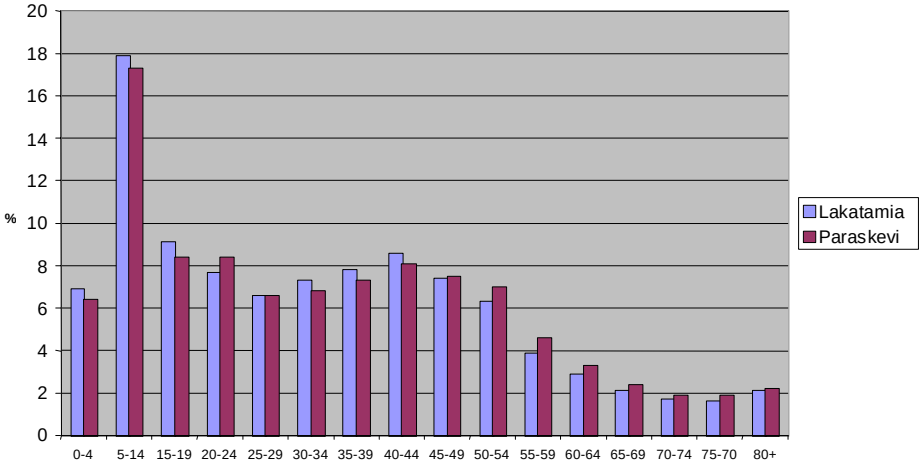
Figure 1
Age structure of Lakatamia and Mammas



much higher proportion of old people. Fewer than 10% of Ayios Mammas are aged under 15 years compared to 25% for Lakatamia as a whole. Anthoupolis has the highest percentage of under-15s (27.8%). Ayios Mammas has almost three times more people aged over 55 years compared to the other areas. Ayia Paraskevi has a slightly higher percentage of people aged over 55 (16.2%) than the other areas.

Based on the age structure, we would expect Ayios Mammas to have the highest incidence of age related cancers. Figure 1 compares the age structure of Ayios Mammas with Lakatamia. Ten year age bands are used except for the first band, which presents the number of under fives. As we saw above, Ayios Mammas has a vastly different age profile from the rest of Lakatamia with a far higher proportion of people in the older age range. It is interesting to note that Ayios Mammas has a higher proportion 20-24 age

Figure 2
Age structure comparing Lakatamia and Paraskevi

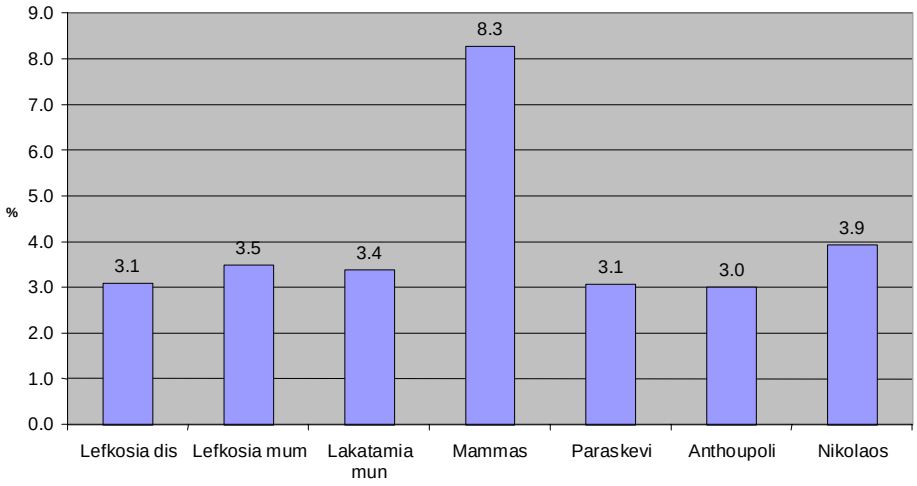


band. Figure 2 compares the age structure of Ayia Paraskevi with Lakatamia. Note that the age profile of Paraskevi is very similar to that of Lakatamia, except that it has slightly more people in the age bands above 50.

2. UNEMPLOYMENT DATA

One of the strongest indicators of social deprivation is unemployment. From census data we have analysed the employment status of Lakatamia. Figure 3 shows the percentage of

Figure3
Percentage unemployed among economically active population



unemployment comparing the areas within Lakatamia with Lefkosia district. The percentage of unemployed is remarkably similar between all the areas, (which have just over 3% of the economically active population unemployed) with the exception of Ayios Mammas, which has over 8% unemployed.

3. EDUCATIONAL ATTAINMENT

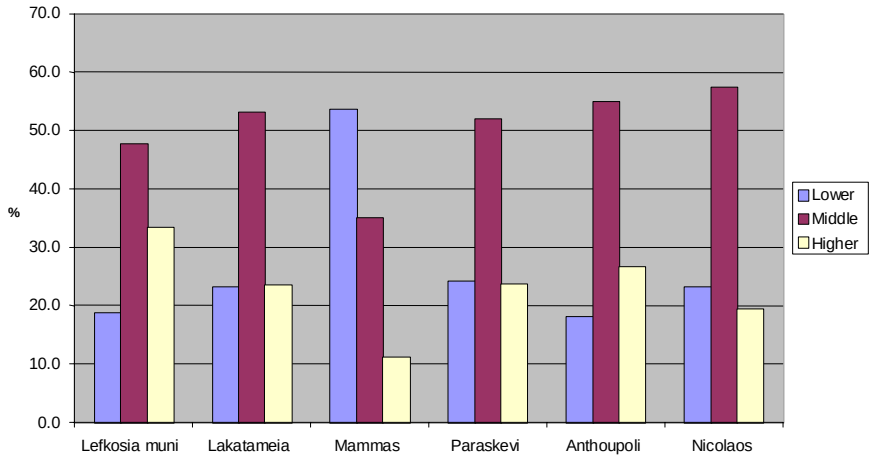
The census collected data on the educational attainment of persons aged 15 and over. We obtained data for Lakatamia areas with six digits codes in order to compare levels of education within the index area. We classified education attainment into three groups. The Lower group included those who obtained a primary education or less; the middle group included gymnasium and lyceum, and the higher group included tertiary, university and doctorate studies. Figure 4 shows the result of our analysis.

The education profile of Lakatamia has slightly lower proportion of people with higher education compared to Lefkosia municipality. For example, 33.6% of people in Lefkosia have attained a higher qualification compared to 23.6% in Lakatamia municipality. Within Lakatamia, Ayios Mammas has a very different education profile, with the majority (54%) of people having attained only a primary education. The profile of Ayia Paraskevi is very similar to that of the municipality as a whole.

4. COMMENTS

1. The age profile of Lakatamia municipality is slightly younger than the national picture. However, Ayia Paraskevi has an age profile that is very similar to that of Lakatamia. Ayios Mammas has a very old age structure and, because most cancers are strongly age dependent, we would expect it to have higher incidence of cancer.

Figure 4
Level of educational attainment



2. The educational attainment data, a good proxy for deprivation, suggests that the population of Lakatamia is slightly more deprived than that of Lefkosia municipality. Ayia Paraskevi has a similar socio-economic profile to Lakatamia. Ayios Mammas not only has a significantly higher level of deprivation, it also has an age profile that is substantially older than the general population. The unemployment rate and the education profile of Ayia Paraskevi is virtually the same as that of Lakatamia.
3. We anticipate from a socio-economic perspective, that Lakatamia will have slightly more cancers than Lefkosia municipality, and that Ayios Mammas, in particular, will have a high incidence of cancer because of its age structure and social deprivation.

Section 5: Routine sources of data

Part 1. Statistical Methods and Data Limitations

5.1 INTRODUCTION

In this section we analyse routine sources of data, namely mortality, cancer registry and hospital activity data, to investigate the geographic distribution and frequency of cancers. The section is divided into four parts, the first deals with statistical methods, and the next three with the sources of data. We have chosen Cyprus as the standard for comparison between various geographic areas. The analysis presents data for the five districts of Cyprus (Government controlled), and then focuses on municipalities within Lefkosia district that are close neighbours of Lakatamia municipality. The index area of the perceived cluster covers two Quarters within Lakatamia, namely Ayia Paraskevi and Ayios Mammas. Where the geographic coding permits it, we compared the four Quarters within Lakatamia.

5.2 STATISTICAL METHODS

The basic measure of the frequency of disease incidence, hospitalisation or mortality is the number of events observed. However, to properly investigate the distribution of disease and to make comparisons between different populations, the denominator population-years at risk in which the observed events occurred must also be taken into account.

5.2.1 Crude Rates

The simplest method to take into account the denominator population is the Crude Rate. This is simply the number of observed events is divided by the population-years at risk. In this report crude rates are expressed per 100,000 population.

The crude rate, *r*, expressed per 100,000 population is given by:

$$r = \frac{O}{n} \times 100{,}000$$

where:
O is the number of observed events;
n is the population-years at risk.

The population-years-at-risk, *n*, is given by the appropriate population figure from the 2001 Census of Cyprus, multiplied by the number of years in the period being observed.

5.2.2 Age Standardisation

Disease incidence, hospitalisation and mortality rates may vary widely by age. Such variation complicates any comparisons made between two populations that have different age structures and is not accounted for by the use of crude rates.

What is needed is a single, easily interpreted, summary figure for each population that is adjusted to take into account its age structure. Such summary figures are calculated using age standardisation methods. Two different methods of age standardisation are commonly used:

1. Direct Method

The rate of events that would occur in a chosen standard population is found by applying the age-specific rates of the subject population to the age structure of the standard population.

2. Indirect Method

The age-specific rates of a chosen standard population (usually the relevant national or regional population) are applied to the age structure of the subject population. This gives an expected number of events against which the observed number of events may be compared.

5.2.3 Directly Age Standardised Rates

The directly age-standardised rate is the rate of events that would occur in a standard population if that population were to experience the age-specific rates of the subject population. Explicitly:

$$DSR = \frac{\sum_i w_i r_i}{\sum_i w_i} \times 100{,}000 \quad \text{(expressed per 100,000 population)}$$

where:
w_i is the number, or proportion, of individuals in the standard population in age group i.
r_i is the crude age-specific rate in the subject population in age group i, given by:

$$r_i = \frac{O_i}{n_i}$$

where:
O_i is the observed number of events in the subject population in age group i.
n_i is the number of individuals in the subject population in age group i.

In this report, the standard population used is the WHO's European Standard Population, broken down into the age groups: 0-4, 5-14,…, 65-74, 75+.

The same standard population is used for males, females and persons. This means that rates can be compared across gender but also that rates for persons are standardised for age only, and not for sex.

The 95% confidence intervals for the directly age-standardised rates are calculated using a log-normal approximation. Standard errors for the *DSR* are obtained using the method described by Breslow and Day,[1] (but modified to use the binomial variance for a proportion to estimate the variances of the crude age-specific rates[2]) and are converted to the log-scale where they are used to calculate limits using a normal approximation. These limits are then transformed back to the original scale using the exponential function. This method is likely to be unreliable when there are fewer than 50 cases in an area, hence confidence intervals for rates based on less than 50 cases should be viewed with caution. The lower and upper limits for the rates are denoted by

$$DSR_{LL/UL} = exp\left(ln(DSR) \pm 1.96 \times \left(\frac{100{,}000}{DSR} \times \sqrt{\frac{1}{\left(\sum_i w_i\right)^2} \times \sum_i \frac{w_i^2 \cdot r_i(1-r_i)}{n_i}} \right) \right)$$

DSR_{LL} and DSR_{UL} respectively.

(expressed per 100,000 population)

where:
w_i is the number, or proportion, of individuals in the standard population in age group i;
r_j is the crude age-specific rate in the subject population in age group i;
n_j is the number of individuals in the subject population in age group i;
exp is the exponential function;
ln is the natural logarithm function.

5.2.4 Indirectly Standardised Ratios

The statistic most commonly presented for the indirect method of age standardisation is

$$ISR = \frac{O}{E} \times 100 \quad = \quad \frac{\sum_i O_i}{\sum_i E_i} \times 100 \quad = \quad \frac{\sum_i O_i}{\sum_i n_i \lambda_i} \times 100$$

the indirectly standardised ratio - the ratio of the observed to expected events. For presentation purposes in this report, the ratio is multiplied by 100, i.e.
where:
O_i is the observed number of events in the subject population in age group i;
E_i is the expected number of events in the subject population in age group i;
n_i is the number of individuals in the subject population in age group i;
λ_i is the crude age-specific rate in the standard population in age group i;

In this report, the standard rates used for indirectly standardised ratios are those of the whole of Cyprus Government controlled area, for age groups: 0-4, 5-14,…, 65-74, 75+. By definition, this standard area has a ratio of 100; Ratios above 100 indicate that the number of events observed was greater than expected given the standard rates, and ratios below 100 that it was lower.

Male and female ratios are calculated using separate male and female standard rates, and cannot be compared; Person ratios are found by summing the separately calculated male and female expected events, rather than by using the standard rates for persons; This means that the person ratios are standardised for both age and sex.

To calculate the 95% confidence intervals for indirectly standardised ratios, it is assumed that the standard rates come from a population sufficiently large as to assume their sampling variance is negligible, and that the observed number of events *O* follows a Poisson distribution. Byar's approximation to the Poisson distribution is then used to calculate the limits.[3] The 95% limits are given by:

$$ISR_{LL} = \frac{O}{E} \times \left(1 - \frac{1}{9O} - \frac{1.96}{3\sqrt{O}}\right)^3 \times 100$$

$$ISR_{UL} = \frac{(O+1)}{E} \times \left(1 - \frac{1}{9(O+1)} + \frac{1.96}{3\sqrt{(O+1)}}\right)^3 \times 100$$

where:
O is the total observed number of events in the subject population;
E is the total expected number of events in the subject population.

5.2.5 Funnel Plots

In this paper we make use of a graphical presentation known as a 'funnel plot'. This is a form of control chart and has been recommended as a graphical aid for making comparisons between health authorities, hospitals, surgical teams or even an individual named surgeons.[4] Funnel plots are flexible, simple, and avoid spurious ranking of observations into 'league tables'. In such charts observations that are assumed to be subject to variation as a result of a common cause (such as random variation, and/or variation as a result of a known risk factor) are described as being 'in-control'. Extreme observations which may be assumed to be subject to variation as a result of some special cause (e.g. a point environmental source) are described as being 'out-of-control'.

The main components of a funnel plot are:

1. The observed estimates of the underlying indicator plotted against a measure of their precision. In this paper the indirectly standardised ratios are plotted against the expected number of events (deaths, registrations etc);

2. The expected underlying value of the indicator for the 'in-control' observations shown as a horizontal line. In our case this the indirectly standardised ratio for Cyprus (=100);

3. The control limits. These are the confidence intervals of the expected underlying value at the given level of precision. They represent the limits of the distribution of 'in-control' observations. As the level of precision increases the control limits become narrower such that they form a funnel shape around the expected underlying value. It is usual to plot both the 95% and 99.8% confidence limits, corresponding to 1.96 and 3.09 standard deviations respectively, with the 99.8% limits forming the demarcation between 'in-control' and 'out-of-control' observations.

It should be noted that the control limits plotted in this report are based solely on the random variation inherent in the statistic. They do not take into account any additional variation that may be the result of 'legitimate' (for the purpose of this study) risk factors such as deprivation (except for age and sex which is accounted for in the construction of the indirectly standardised ratio).

5.3 CENSUS DATA

In order to calculate the crude rates, directly age-standardised rates, and indirectly age-standardised ratios described above it is necessary to have population denominators broken down by age and sex for the areas of interest. In all instances, the population denominators used in this report are sourced from the Census of Population 2001 published by the Statistical Service of Cyprus (CYSTAT), a department of the Ministry of Finance.[5]

The Census populations are presented by sex and 5-year age groups 0-4, 5-14,…75-79, and 80+. A large number of Communities, however, have very small populations and a population of zero within a particular 5-year age/sex group is not uncommon. This can have problematic effects on some of the age-standardisation calculations. To reduce the frequency of such occurrences we have aggregated the data into 10-year age groups 0-4, 5-14,…65-74, 75+ for standardisation.

For hospital inpatient records and cancer registrations numerator data is available for the 5-year period 1998-2002. Mortality data is available for the 5-year period 2000-04. In order to estimate the appropriate population-years-at-risk denominators, the Census population counts are multiplied by the number of years in the period.

1 Breslow NE and Day NE. *Statistical Methods in Cancer Research, Volume II*: *The Design and Analysis of Cohort Studies*. Lyon: International Agency for Research on Cancer, World Health Organization, 1987: 59.

2 Keyfitz N. Sampling variance of age-standardised mortality rates. *Human Biology*. 1966; 38: 309-317.

3 Breslow NE and Day NE. *Statistical Methods in Cancer Research, Volume II*: *The Design and Analysis of Cohort Studies*. Lyon: International Agency for Research on Cancer, World Health Organization, 1987: 69.

4 Spiegelhalter DJ. Funnel plots for comparing institutional performance. *Statistics in Medicine* 2005; 24:1185–1202.

5 CYSTAT. Table 3a. Population by sex, age, District, Municipality/Community and Quarter, *Census of Population 2001 Volume II Data by District, Municipality/Community*. Lefkosia: Republic of Cyprus, 2004.

Section 5: Routine sources of data

Part 2: Mortality Data

5.4 DEATH REGISTRATIONS

5.4.1 Source of Data

Data on death registrations in Cyprus were obtained from the Ministry of the Interior. The data were in the form of individual records for each death where the data of registration was in the period 2000-04. The records contained the following data items:

- Registry ID;
- Name;
- Sex;
- Date of birth;
- District of birth (uncoded);
- Community/Municipality of birth (uncoded);
- Quarter of birth (uncoded);
- District of permanent residence (uncoded);
- Community/Municipality of permanent residence (uncoded);
- Quarter of permanent residence (uncoded);
- Address of permanent residence;
- Date of death;
- District of informant's residence (uncoded);
- Community/Municipality of informant's residence (uncoded);
- Quarter of informant's residence (uncoded);
- District of Registration (uncoded);
- Date of registration;
- Cause of death code (European Short List of Causes);
- Cause of death title.

The following fields were also derived:

- Age at death (years);
- Area of permanent residence (4-digit Municipality/Community code);
- Quarter of permanent residence (6-digit Quarter code).

5.4.2 Data Quality

1) Coverage

The coverage of the death registration system is a concern. Table 5.1 shows the annual count of death registrations by district over the period 2000-2004. The number of registrations has approximately doubled over the period and it can be assumed that is mostly the result of improvement in the coverage of the registration system rather than an increase in mortality. The pattern is similar for all of the districts except Larnaca, where

the number of registrations has remained relatively stable around an average of 700 per year. However, it is not possible to say whether this represents a consistent level of high coverage, or a situation where the registration coverage for Larnaca has not improved in the same way as it has for other districts. In any case the data set has a large amount of missing data, which may result in biases when making geographical comparisons, particularly for areas in the Larnaca district.

2) Completeness

Table 5.2 shows the percentage of death registrations missing key data items by year of registration. Sex and age (derived from date of birth and date of death) are present in all registrations. It should be noted however that there is evidence that some of the ages derived are probably based on erroneous dates of birth. In total there were 488 registrations with a derived age of 100 years or over, representing 2.1% of all death registrations. This compares with a figure of 0.7% in England and Wales in 2003, despite the fact that England & Wales has a higher proportion of elderly people than does Cyprus (proportions aged over 80 years are 4.4% and 2.6% respectively).

The 4-digit Municipality/Community code for the area of permanent residence was not available for 6.2% of the death registrations. This figure remained fairly consistent across the time period. The proportion of registrations for which a cause of death was not recorded improved from 72% in 2000 to 5.7% in 2003. However, it then worsened to 19% in 2004. Overall, approximately one Quarter of the registrations did not specify the cause of death.

Table 5.3 shows the missing data items by district. The areas of residence columns indicate registrations where the district of permanent residence was recorded but the Municipality/Community was not. Such records are omitted from the geographical analyses. It can be seen that areas in Ammochostos district may therefore be affected by missing area data more than the other districts.

There is a significant variation in the completeness of recording the cause of death between the districts. Lemesos and Lefkosia districts had the lowest proportion of missing cause of death data at approximately 21% of registrations. Ammochostos had the highest with 46%. In the key Municipality of interest, Lakatamia, 21% of registrations did not record a cause of death. Within the Quarters of Lakatamia there was also a large degree of variation, with the index Quarters of Ayios Mammas and Ayia Paraskevi having 28% and 26% of registrations with missing cause of death respectively, and Archangelos – Anthoupolis and Ayios Nicolaos having 8% and 9% respectively.

5.4.3 Limitations of the Data

The hospital inpatient records and cancer registrations data sets are limited by the fact that even with 100% coverage and completeness they are either indirect or incomplete

measures of the actual variable of interest, i.e. disease incidence. This is not the case for the death registrations, which are a direct and potentially complete measure of the mortality from a disease. The usefulness of the data set is limited only by its data quality, i.e. its coverage and completeness. As described above, there are serious shortcomings in both these aspects of data quality. The coverage of the death registration system has improved considerably over the period and these efforts are to be commended. Further improvements are required in the completeness of the data recorded, in particular the cause of death.

In addition, there are further problems associated with the coding scheme used to record the cause of death. The scheme is based on the European Short List of 65 causes of death developed by Eurostat for the dissemination of mortality statistics across Europe.[1] The use of additional codes outside of these 65 was also observed. This European Short List was designed for use when *reporting* mortality statistics and has some shortcomings when being used to *code* mortality data. An example of this is shown in table 5.4 which gives the subset of the European Short List that relate to cancer and the count of registrations coded to each.

When used to report statistics, cause 7 ‘Malignant Neoplasms’ is used to give a total figure for all deaths caused by malignant neoplasms. The causes 8 through 23 are then used to give sub-totals for selected specific neoplasms. Cause 7 includes all of causes 8 to 23 and *also any other specified neoplasms and unspecified neoplasms*.

When coding deaths, causes that match any of the selected specific neoplasms are coded accordingly. Both other specified neoplasms and unspecified neoplasms are coded to cause 7 ‘Malignant Neoplasms’. The count of registration presented against cause 7 in the table is therefore the total of the other and unspecified neoplasms and does not include the counts for causes 8 to 23. It would be more appropriate to label this cause ‘Malignant Neoplasms – Other and Unspecified’.

It is not possible to differentiate between registrations with other neoplasms and those with unspecified neoplasms. This is a problem as it is desirable to know the proportion of unspecified neoplasms as these are, in effect, missing data and will affect the confidence that can be placed in the counts given for any of the specific neoplasms listed. Given that causes 8 through 23 represent the most common cancers it is unusual to find over 50% of the cancer counts being assigned to cause 7 (By comparison in England & Wales 2004 only 26% of cancer death registrations would have been coded to cause 7).[2] The reasonable explanation for this is that for most of these registrations the neoplasm was not specified, i.e. the cause of death given on the certificate was ‘Cancer’ or ‘Malignant neoplasm’ without any further details. This being the case, the counts given for the specific neoplasms must be viewed with caution as they are underestimates of the true counts. Variations between Doctors and Registrars in how cause of death is recorded during death certification and registration may result in artefactual differences between

different populations in their mortality rates for specific causes. The potential for this is illustrated further in table 5.5. where the proportion of cancer deaths assigned to other/unspecified neoplasms is shown by District, and the Municipality and Quarters of Lakatamia. At the district level this varied from 41% to 68%, and within Lakatamia from 38% to 54%.

Given the size of and variation in the proportion of potentially missing information, using the death registrations for geographical comparisons of the mortality from specific cancers is considered to be unreliable and inappropriate. Analysis for All Cancers, i.e. causes 7 to 23 combined, is included but even this should be interpreted with caution given the problems with coverage and the large proportion of registrations where no cause of death at all is recorded.

5.4.4 Analysis

For the analysis only those death registrations with complete and valid age, sex and 4-digit area of residence codes were included. There were 21,495 such registrations, representing 93.8% of the total 22,914 registrations recorded for the Government Controlled area of Cyprus during the period.

1) All Causes Of Death

In the period 2000-2004 there were 492 death registrations of Lakatamia Municipality residents. Of these 275 were male and 217 female. Both direct rates and indirect ratios suggest that all cause mortality in Lakatamia Municipality (ISR=74.1, 95%CI: 67.7-80.9) was approximately 25% lower than both the Cyprus average and Lefkosia district average (Table 5.6, Figure 5.1). Lakatamia also compares favourably against the other Municipalities in and around Lefkosia City. Within Lakatamia Municipality there was a four-fold variation in all cause mortality between the Quarters. Mortality in Archangelos-Anthoupolis was approximately 65% lower than the Cyprus average (ISR=34.6, 95%CI: 27.2-43.5), whilst mortality in Ayios Mammas was 38% higher (ISR=138.2, 95%CI: 111.1-169.9). Mortality in the index Quarter of Ayia Paraskevi (ISR=88.9, 95%CI: 78.4-100.3) was not unusual and was lower than the Cyprus average. The standardised ratios are illustrated in a funnel plot (Figure 5.2) where they are plotted against the distribution of ratios for all the Municipalities, Communities and Quarters in Cyprus. Lakatamia Municipality and three of its four Quarters can be seen to be below the expected level of mortality. The fourth Quarter, Ayios Mammas, is above the expected level and outside the 95% confidence limits, that is, it is statistically significantly different at the 95% confidence level. It is however, within the 99.8% confidence limits and as such may be considered as being ‘in-control’.

Similar patterns are observed for both males and females. Figures can be found in the full set of tables and figures in Appendix 1.

2) All Cancers

Of the 492 death registrations of Lakatamia Municipality residents, 389 had a recorded cause of death, and of these cancers the cause was recorded for 58 (37 males, 21 females).

Cancer mortality in Lefkosia District as a whole was observed to be approximately 30% higher than for Cyprus (ISR=128.5, 95%CI: 121.2-136.0). Rates were generally high in all of Municipalities in and around Lefkosia with the exception of Geri, Anthoupolis Refugee Housing Estate and Lakatamia (Table 5.7, Figure 5.3). Both direct rates and indirect ratios suggest that cancer mortality in Lakatamia Municipality was approximately 15% lower than the Cyprus average (ISR=83.8, 95% CI: 63.6-108.3).

Within the Quarters of Lakatamia Municipality the pattern for cancer mortality is similar to that observed for all cause mortality. Rates in Archangelos-Anthoupolis were low and rates in Ayios Mammas were high. Rates in the index Quarter of Ayia Paraskevi were low.

Figure 5.4. shows the indirectly standardised ratios on the funnel plot. As before Lakatamia Municipality and the Quarters Archangelos- Anthoupolis, Ayia Paraskevi and Ayios Nicolaos have mortality ratios well below that expected. Ayios Mammas has a high ratio on the borderline of statistical significance at the 95% confidence level. The overall cancer mortality in Ayios Mammas can be considered as high but not extraordinary given the small number of events involved.

Similar patterns are observed for both males and females. Figures are given in tables in Appendix 1.

5.4.5 Conclusions

1. It should be re-iterated that these results should be considered within the context of the poor data quality of the death registrations and artefactual differences in mortality rates may be present. There are also socio-economic and behavioural factors, such as deprivation and smoking, which are associated with increase cancer mortality and could be alternatives to point-source or environmental sources as an explanation of high cancer mortality rates within a given area.

2. Taking into the above concerns, analysis of the mortality data does not provide any evidence of there being an excess of cancer of deaths in Lakatamia Municipality in general, and the main index Quarter of Ayia Paraskevi in particular. The second index Quarter, Ayios Mammas, has high but ‘in-control’ all-cause and all cancer mortality rates, which are probably associated with its unusual socio-economic characteristics.

5.4.6 Recommendations

The exercise has highlighted the inadequacies of the current death registration data for analyses of this sort. In order to improve the data quality of the death registrations such that might be used reliably and routinely in future analyses we recommend that the appropriate responsible body undertake to:

1. Continue the notable improvement in death registration coverage with the aim of ensuring that all deaths in Cyprus (and of Cyprus residents) are certified and registered.
2. Seek to improve the recording of the causes of death on the death certificate, including multiple causes, and introduce full ICD10 coding for registering causes of death. Guidelines for certification and rules for coding mortality records can be found in ICD10 volume III. [3]
3. Improve the recording of information on the address of permanent residence and the provision of the 4 and 6 digit Municipality/Community/Quarter Codes.

TABLES

Table 5.1
Death Registrations
By District and Year of Registration
Cyprus, Registered 2000-2004

District		Year of Registration					Total 2000-04
		2000	2001	2002	2003	2004	
1	LEFKOSIA DISTRICT	1,102	1,939	1,587	1,818	2,195	8,641
3	AMMOCHOSTOS DISTRICT	112	186	196	223	225	942
4	LARNACA DISTRICT	644	551	737	786	752	3,470
5	LEMESOS DISTRICT	722	1,149	1,255	1,284	1,587	5,997
6	PAFOS DISTRICT	199	482	601	491	717	2,490
	Unspecified	142	296	267	297	372	1,374
	Cyprus (Government Controlled)	2,921	4,603	4,643	4,899	5,848	22,914

Source: Ministry of the Interior

Table 5.2
Death Registrations Missing Key Data Items
By Year of Registration
Cyprus, Registered 2000-04

Year	All Registrations	Registrations With Missing:							
		Sex		Age		Area of Residence		Cause of Death[1]	
		No	%	No	%	No	%	No	%
2000	2,921	0	*0.0%*	0	*0.0%*	149	*5.1%*	2,102	*72.0%*
2001	4,603	0	*0.0%*	0	*0.0%*	304	*6.6%*	1,324	*28.8%*
2002	4,643	0	*0.0%*	0	*0.0%*	278	*6.0%*	474	*10.2%*
2003	4,899	0	*0.0%*	0	*0.0%*	306	*6.2%*	278	*5.7%*
2004	5,848	0	*0.0%*	0	*0.0%*	382	*6.5%*	1,109	*19.0%*
2000-04	22,914	0	*0.0%*	0	*0.0%*	1,419	*6.2%*	5,287	*23.1%*

Source: Ministry of Finance

1 - With cause of death code recorded as 0 - 'Not stated' or 57 - 'Unknown and unspecified causes'.

Table 5.3
Death Registrations Missing Key Data Items
By District, Lakatamia Municipality and Quarters
Cyprus, Registered 2000-04

District		All Registrations	Registrations With Missing:			
			Area of Residence		Cause of Death[1]	
			No	%	No	%
1	LEFKOSIA DISTRICT	8641	5	*0.1%*	1,806	*20.9%*
3	AMMOCHOSTOS DISTRICT	942	37	*3.9%*	432	*45.9%*
4	LARNACA DISTRICT	3470	2	*0.1%*	998	*28.8%*
5	LEMESOS DISTRICT	5997	0	*0.0%*	1,249	*20.8%*
6	PAFOS DISTRICT	2490	1	*0.0%*	632	*25.4%*
	Unspecified	1374	1374	*100.0%*	170	*12.4%*
	Cyprus (Government Controlled)	22914	1419	*6.2%*	5287	*23.1%*
1021	Lakatamia	492			103	*20.9%*
102101	Ayios Mammas	90			25	*27.8%*
102102	Ayia Paraskevi	263			66	*25.1%*
102103	Archangelos- Anthoupolis	74			6	*8.1%*
102104	Ayios Nicolaos	65			6	*9.2%*

Source: Ministry of the Interior

1 - With cause of death code recorded as 0 - 'Not stated' or 57 - 'Unknown and unspecified causes'.

Table 5.4
Cancer Death Registrations By Cause of Death
Cyprus, Registered 2000-04

	Cause of Death	Registrations	
		No	***%***
7	Malignant neoplasms	1221	*51.2%*
8	Malignant neoplasms of the lip, oral cavity, pharynx	6	*0.3%*
9	Malignant neoplasms of the oesophagus	13	*0.5%*
10	Malignant neoplasms of the stomach	76	*3.2%*
11	Malignant neoplasms of the colon	135	*5.7%*
12	Malignant neoplasms of the rectum and anus	0	*0.0%*
13	Malignant neoplasms of the liver and intrahepatic bile ducts	51	*2.1%*
14	Malignant neoplasms of the pancreas	90	*3.8%*
15	Malignant neoplasms of the larynx and trachea/bronchus/lung	316	*13.2%*
16	Malignant melanomas of the skin	15	*0.6%*
17	Malignant neoplasms of the breast	183	*7.7%*
18	Malignant neoplasms of the cervix uteri	0	*0.0%*
19	Malignant neoplasms of the other parts of the uterus	0	*0.0%*
20	Malignant neoplasms of the ovary	52	*2.2%*
21	Malignant neoplasms of the prostate	153	*6.4%*
22	Malignant neoplasms of the kidney	51	*2.1%*
23	Malignant neoplasms of the bladder	24	*1.0%*
	Total All malignant neoplasms	2386	*100.0%*

Source: Ministry of the Interior

Table 5.5
Cancer Death Registrations With Unspecified Cancer
By District, Lakatamia Municipality and Quarters
Cyprus, Registered 2000-04

Area		Total All Malignant Neoplasms	With Other/Unspecified Neoplasm	
			No	%
1	LEFKOSIA DISTRICT	1169	496	*42.4%*
3	AMMOCHOSTOS DISTRICT	58	24	*41.4%*
4	LARNACA DISTRICT	321	157	*48.9%*
5	LEMESOS DISTRICT	524	334	*63.7%*
6	PAFOS DISTRICT	216	147	*68.1%*
	Unspecified	98	63	*64.3%*
	Cyprus (Government Controlled)	2386	1221	*51.2%*
1021	Lakatamia	58	27	*46.6%*
102101	Ayios Mammas	13	5	*38.5%*
102102	Ayia Paraskevi	26	14	*53.8%*
102103	Archangelos- Anthoupolis	12	6	*50.0%*
102104	Ayios Nicolaos	7	2	*28.6%*

Source: Ministry of the Interior

Table 5.6
Death Registrations for All Causes of Death
Crude Rate, Directly Standardised Rates, Indirectly Standardised Ratios
By District and Selected Municipalities/Communities/Quarters
Cyprus, Persons, Registered 2000-04

Area		Count	Crude Rate[1]	DSR[1, 2]		Standardised Ratio[4]	
				Rate	*95% CI*[3]	Ratio	*95% CI*[3]
0	Cyprus (Government Controlled)	21495	623.4	557.8	*541.7 - 574.5*	100.0	*98.7 - 101.3*
1	LEFKOSIA DISTRICT	8661	633.0	559.8	*534.4 - 586.4*	100.3	*98.2 - 102.5*
3	AMMOCHOSTOS DISTRICT	896	474.9	538.9	*466.8 - 622.1*	96.1	*89.9 - 102.6*
4	LARNACA DISTRICT	3468	601.7	554.3	*515.1 - 596.4*	99.3	*96.1 - 102.7*
5	LEMESOS DISTRICT	5981	614.8	626.7	*593.3 - 661.9*	114.4	*111.6 - 117.4*
6	PAFOS DISTRICT	2489	750.1	603.4	*553.4 - 657.9*	109.4	*105.1 - 113.7*
1000	Lefkosia Municipality	2047	855.9	614.3	*557.6 - 676.8*	110.6	*105.9 - 115.5*
1010	Ayios Dometios Municipality	471	776.9	556.3	*455.6 - 679.3*	99.8	*91.0 - 109.2*
1011	Egkomi Municipality	224	328.3	395.1	*296.0 - 527.3*	70.4	*61.5 - 80.2*
1012	Strovolos Municipality	1346	460.0	462.5	*411.4 - 519.9*	82.7	*78.4 - 87.3*
1013	Aglantzia Municipality-Aglangia	451	475.9	456.7	*372.9 - 559.5*	81.9	*74.5 - 89.8*
1021	**Lakatamia Municipality**	**492**	**345.5**	**416.6**	***341.0 - 509.0***	**74.1**	***67.7 - 80.9***
1022	Anthoupolis Refugee Housing Est.	140	1123.6	578.0	*383.6 - 870.8*	97.4	*81.9 - 114.9*
1023	Latsia Municipality (Lakkia)	313	513.3	556.3	*436.2 - 709.4*	99.8	*89.0 - 111.5*
1024	Geri	130	403.5	561.5	*380.7 - 828.4*	100.7	*84.1 - 119.5*
102101	Ayios Mammas	90	1572.1	797.2	*487.0 - 1305.1*	138.2	*111.1 - 169.9*
102102	Ayia Paraskevi	263	446.1	488.6	*373.1 - 639.8*	88.9	*78.4 - 100.3*
102103	Archangelos- Anthoupolis	74	131.0	206.5	*120.0 - 355.2*	34.6	*27.2 - 43.5*
102104	Ayios Nicolaos	65	306.7	403.0	*232.3 - 699.0*	72.6	*56.0 - 92.5*

Source: Ministry of the Interior

1 – Crude rates and DSRs are expressed per 100,000 population per year
2 – DSRs use the European Standard Population.
3 - 95% confidence interval
4 - Indirectly Standardised Ratios and Indirectly Standardised Proportional Ratios use Cyprus (Government Controlled) rates as the standard.

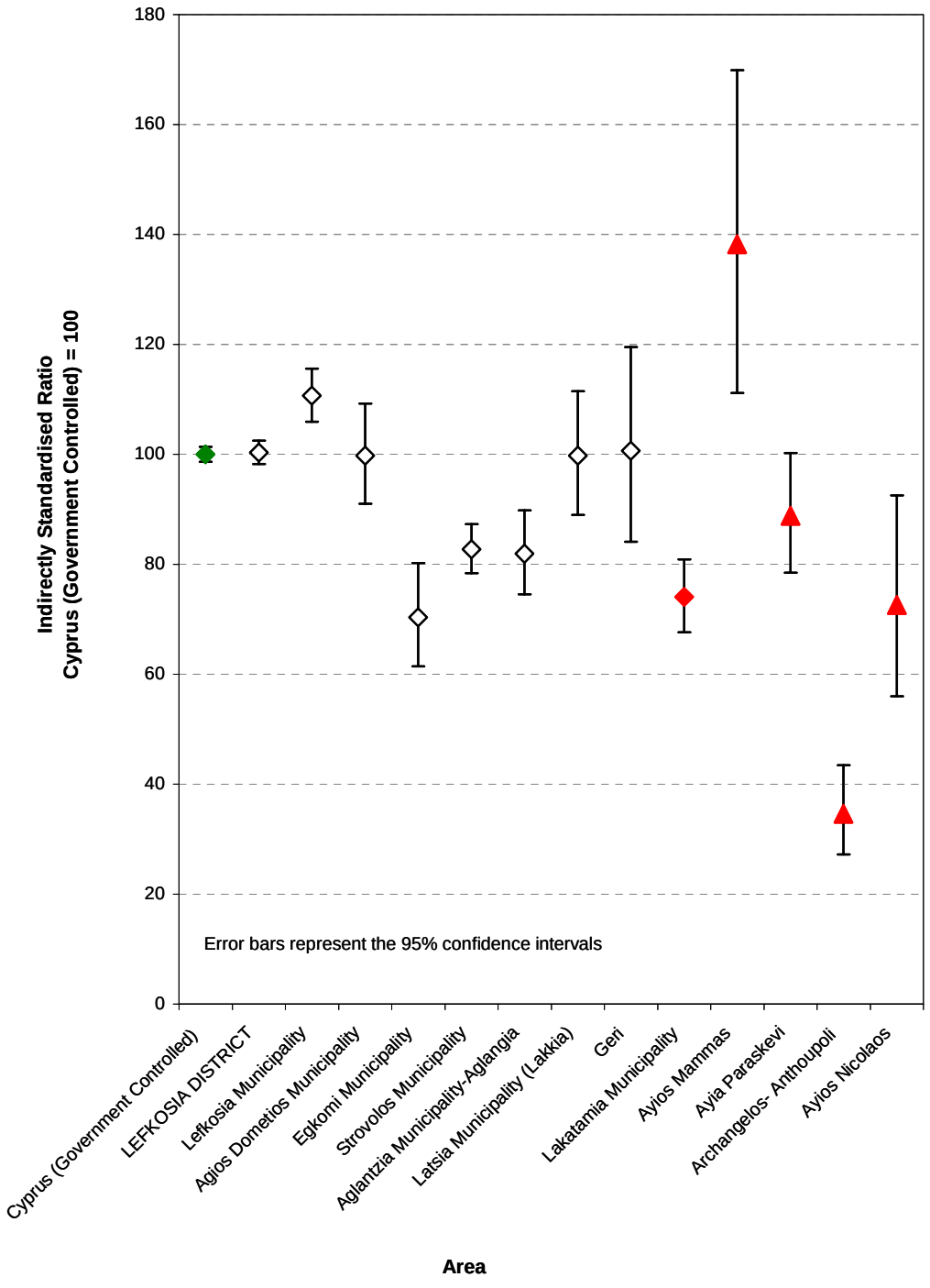
Table 5.7
Death Registrations for All Cancers (ESL65 Cause of Death Codes 7-23)
Crude Rate, Directly Standardised Rates and Indirectly Standardised Ratios
By District and Selected Municipalities/Communities/Quarters
Cyprus, Persons, Registered 2000-04

Area		Count	Crude Rate[1]	DSR[1, 2]		Standardised Ratio[4]	
				Rate	*95% CI*[3]	Ratio	*95% CI*[3]
0	Cyprus (Government Controlled)	2,286	66.3	64.1	*58.4 - 70.3*	100.0	*95.9 - 104.2*
1	LEFKOSIA DISTRICT	1,173	85.7	81.7	*71.8 - 93.0*	128.5	*121.2 - 136.0*
3	AMMOCHOSTOS DISTRICT	57	30.2	36.2	*20.2 - 64.9*	55.3	*41.9 - 71.6*
4	LARNACA DISTRICT	321	55.7	56.5	*44.1 - 72.4*	86.8	*77.6 - 96.8*
5	LEMESOS DISTRICT	519	53.4	54.7	*45.2 - 66.3*	89.0	*81.5 - 97.0*
6	PAFOS DISTRICT	216	65.1	58.6	*43.3 - 79.3*	90.6	*78.9 - 103.5*
1000	Lefkosia Municipality	296	123.8	98.6	*75.9 - 127.9*	156.6	*139.2 - 175.5*
1010	Ayios Dometios Municipality	70	115.5	90.3	*53.1 - 153.6*	137.9	*107.5 - 174.2*
1011	Egkomi Municipality	47	68.9	84.7	*44.6 - 160.8*	129.5	*95.2 - 172.3*
1012	Strovolos Municipality	235	80.3	82.2	*61.8 - 109.4*	128.5	*112.6 - 146.1*
1013	Aglantzia Municipality-Aglangia	74	78.1	75.7	*45.4 - 126.1*	120.6	*94.7 - 151.4*
1021	**Lakatamia Municipality**	**58**	**40.7**	**54.3**	***30.0 - 98.5***	**83.8**	***63.6 - 108.3***
1022	Anthoupolis Refugee Housing Est.	16	128.4	64.4	*19.9 - 208.4*	104.6	*59.8 - 169.9*
1023	Latsia Municipality (Lakkia)	53	86.9	94.9	*51.8 - 173.6*	153.1	*114.7 - 200.3*
1024	Geri	11	34.1	54.8	*13.8 - 216.6*	81.0	*40.4 - 144.9*
102101	Ayios Mammas	13	227.1	143.1	*35.8 - 571.6*	197.4	*105.0 - 337.5*
102102	Ayia Paraskevi	26	44.1	53.8	*22.3 - 129.6*	83.7	*54.6 - 122.6*
102103	Archangelos- Anthoupolis	12	21.2	32.9	*8.5 - 127.8*	54.8	*28.3 - 95.7*
102104	Ayios Nicolaos	7	33.0	43.0	*7.7 - 241.8*	72.4	*29.0 - 149.1*

Source: Ministry of the Interior

1 – Crude rates and DSRs are expressed per 100,000 population per year
2 – DSRs use the European Standard Population.
3 - 95% confidence interval
4 - Indirectly Standardised Ratios and Indirectly Standardised Proportional Ratios use Cyprus (Government Controlled) rates as the standard.

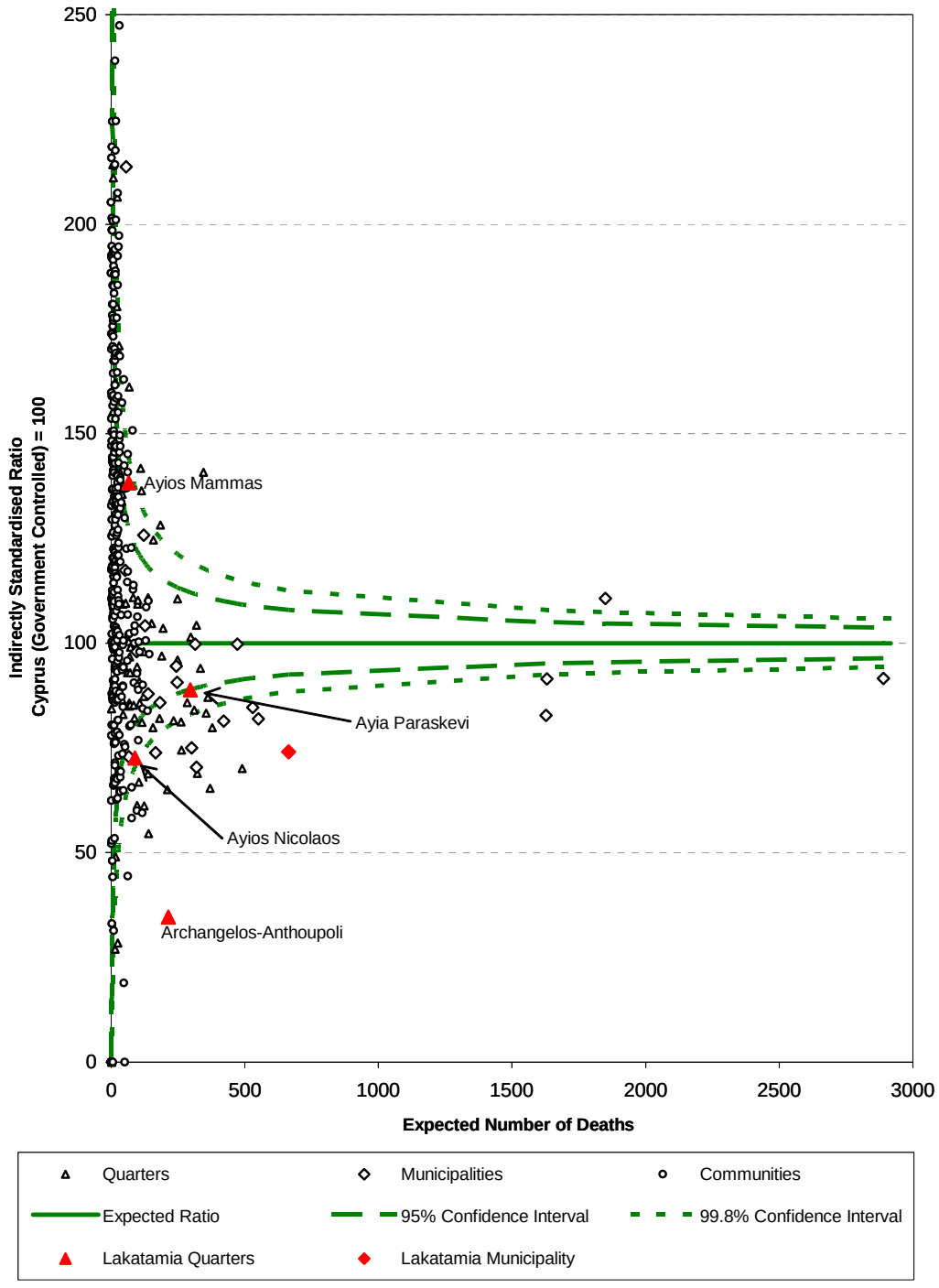
Figure 5.1
Death Registrations for All Causes of Death
Indirectly Standardised Ratios by Selected District/Municipality/Community/Quarter
Cyprus, Persons, Registered 2000-04



Source: Ministry of the Interior

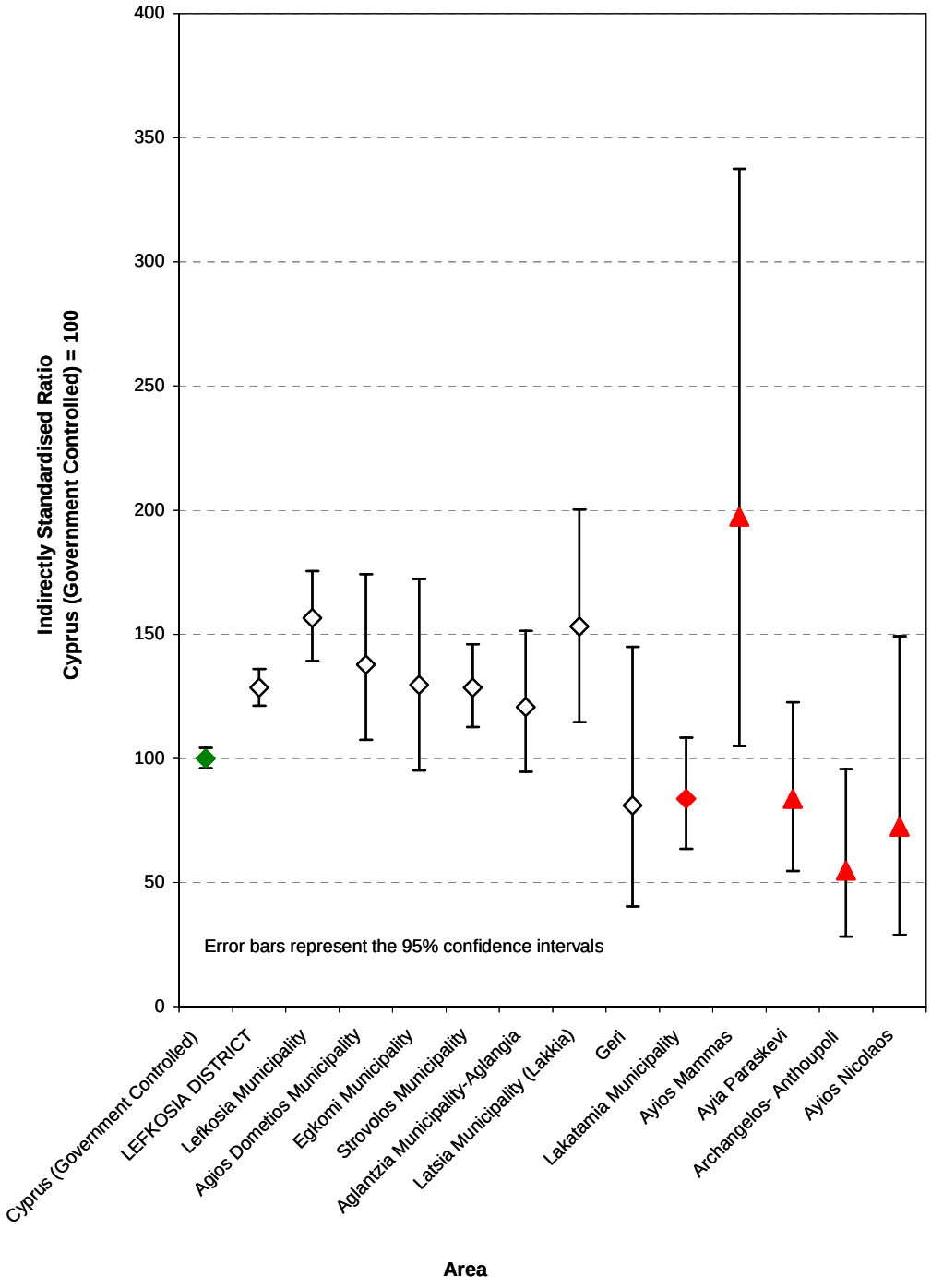
Figure 5.2

Death Registrations for All Causes of Death
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Persons, Registered 2000-04



Source: Ministry of the Interior

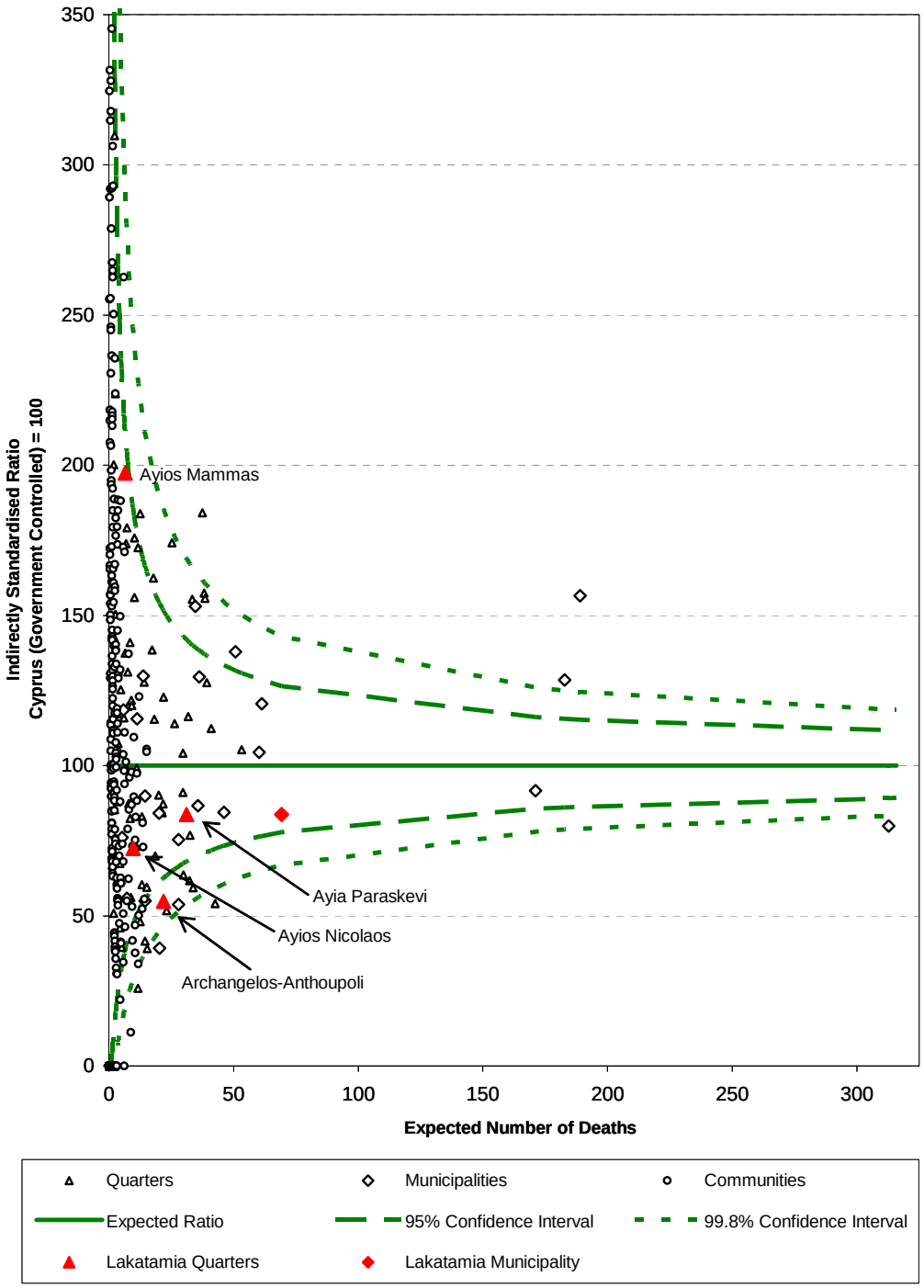
Figure 5.3
Death Registrations for All Cancers (ESL65 Cause of Death Codes 7-23)
Indirectly Standardised Ratios by Selected District/Municipality/Community/Quarter
Cyprus, Persons, Registered 2000-04



Source: Ministry of the Interior

Figure 5.4

Death Registrations for All Cancers (ESL65 Cause of Death Codes 7-23)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Persons, Registered 2000-04



Source: Ministry of the Interior

1 Eurostat. *Causes of death: 1994-1995 statistics*. Eurostat Working Papers: Population and social conditions 3/1998/E/N° 22. Luxembourg: Eurostat, 1998.

2 Office for National Statistics. Table 2 in Report: Death registrations in England and Wales, 2004: causes. *Health Statistics Quarterly* Summer 2005; 26: 62-69.

3 WHO. *International Statistical Classification of Diseases and Related Problems, Tenth Revision, Volume 2 Instruction Manual*. Geneva: WHO, 1992.

Part 3. Cancer Registry Data

5.5 CANCER REGISTRATIONS

5.5.1 Source of Data

Data on cancer registrations in Cyprus were obtained from the Ministry of Health. The registry collates histological confirmations of cancer diagnoses from hospital and histology centres in Cyprus, but does not routinely collate data from death registrations. The data were in the form of individual records for each cancer registration where the date of registration was in the period 1998-2002. The records contained the following data items:

- Name;
- Identification Number;
- Age;
- Sex;
- Address;
- Area of Permanent Residence (4-digit Community/Municipality code);
- District of Permanent Residence;
- Topography;
- Morphology;
- Hospital/Clinic;
- Year of Registration.

During data cleaning and processing further fields were derived:

- Record Status (Valid registration, duplicate, uncertain);
- Registration Order (Order number of multiple valid registrations for the same individual);
- Diagnosis (ICD10 code based on topography and morphology).

5.5.2 Data Quality

1) Coverage

It is difficult to assess to what extent the registry collects all histological confirmations of cancer. To the best of our knowledge the registry records all histologically confirmed cancers that are treated in the state hospitals as well as the Oncology Department run by the Bank of Cyprus. Cancers treated in private clinics are obtained from the pathology laboratory run by the Bank of Cyprus. We can therefore be confident that the registry ascertains cancers that are treated by the medical services, both state and private.

Table 5.8 shows the count of registrations by District and year. Over the period the annual number of registrations has increased in all Districts, with an overall national increase of approximately 15%. It is not possible to say whether this increase is a result of an increased

incidence of cancer, improved access to histological testing in suspected cancer cases or improved registration of histological test results. However, there does not appear to be any unusual inconsistency in the counts across the Districts and years.

2) Duplicate Records and Multiple Registrations

As part of the data quality assessment process searches were made for potential duplicate registrations. Table 5.9 shows the results of a search for records with the same national Identification Number. The additional personal information in the records, such as age, sex, place of residence, type of cancer were then used to determine whether or not these represented duplicate registrations or multiple registrations, each for a different cancer, for the same person.

Of the 97 matching pairs found, 3 included a duplicate registration, 57 were multiple registrations for the same individual, and 18 involved erroneous ID numbers such that the registrations were not related to the same individuals. The exact nature of a further 9 matching pairs of registrations could not be determined from the data available.

Further manual cleaning was conducted to compare records with identical names and diagnoses. This resulted in the identification of additional 9 duplicate registrations, 14 multiple registrations, and 9 registration-pairs where there were insufficient data to determine for certain if the matched registrations related to the same individual.

For the analyses in this report the duplicate registrations and registrations where the type of match could not be determined were excluded. Where there are multiple registrations for a given individual the registry does not record whether the subsequent registrations are of secondary cancers or of new unrelated primary cancers. Therefore, all multiple registrations have been assumed to be of primary cancers and are included in the analyses.

3) Completeness

Table 5.10 shows the proportion of cancer registration records missing key data items, broken down by the year of registration. The patient's sex was recorded in 100% of registrations, as was the topography and morphology of the histological confirmation use to generate the ICD10 diagnosis code (i.e. the type of cancer). Only 1.8% of the registrations were missing the patient's age and there was not the problem of improbably old ages being recorded as was observed in the mortality registrations. Only one registration recorded an age of over 100 years. Coding of the 4 digit Municipality/Community code for the area of permanent residence has improved over the period with missing rates falling from 6.7% in 1998 to 2.7% in 2002. The overall level of missing area codes was 5.3%, which is a similar level to that observed for the mortality registrations.

Table 5.11 shows the proportion of missing areas codes broken down by the main hospitals and clinics from which registrations were received. By far the majority of registrations are supplied by Central Oncology Clinic and Lefkosia General Hospital. Both these sources

provide very good completeness of the area of permanent residence field. Larnaca hospital on the other hand has poor completeness with over half the registration supplied missing a valid permanent residence area code. The volume of registrations supplied by Larnaca hospital is small but the missing data may still affect the estimated rates and ratios for Municipalities and Communities it serves.

Information on the area of permanent residence is not routinely coded to the 6-digit Quarter code. However the records do include the street address of the patient. For Lakatamia residents only, this street address was used to manually allocate the records to the four Quarters of Ayios, Mammas, Ayia Paraskevi, Archangelos-Anthoupolis and Ayios Nicolaos. This allocation was double-checked with the Mayor of Lakatamia's office. There were 339 registrations originally recorded by the cancer registry as being resident in Lakatamia Municipality and they were allocated to the Quarters as shown in Table 5.12. Street addresses were either missing or unable to be allocated to a Quarter in 13 registrations (3.8%). The table, however, shows that there were some errors in the original coding of Municipality/Community of residence. Thirty-one records were actually resident in Anthoupolis Refugee Housing Estate. This is probably a result of the cancer registry treating the estate as part of Lakatamia, whereas it ought to be treated as a separate Community in its own right. A further 7 records were found to lie within Strovolos Municipality. For the purposes of the analysis these records were reassigned to their correct area of residence resulting in a revised total of 301 registrations in Lakatamia Municipality.

Assuming that all the records with missing or unallocatable addresses are actually within Lakatamia and none are in Anthoupolis Refugee Housing Estate or Strovolos, then the proportion of registrations missing the Quarter data rises to 4.3% of the revised total for Lakatamia Municipality. This level of missing Quarter data may not seem very high but it does have implications for the comparison of registration rates. Firstly, if the missing registrations are in actuality randomly distributed among the Quarters then comparisons between the Quarters are not adversely affected. However, comparisons between the Quarters and the whole of Lakatamia or other areas are affected as the rates for the Quarters will be underestimated by approximately 4% on average. Secondly, if the missing registrations are non-randomly distributed then any differences observed between the Quarters and against the whole of Lakatamia or other areas may be artefactual.

5.5.3 Limitations of the Data

The cancer registry is presumed to have a very high coverage of the histological confirmations of cancer being made and its data quality is generally very good. However there are still limitations in its use as a proxy for the incidence of cancer. Patients with poor access to medical services in general and cancer diagnostic services in particular will be less likely to have a histological confirmation made and their cancer registered. Differences in the case management of suspected cancer sufferers may also lead to differences in their chances of registration. In many countries such patients may be subsequently picked up by the routine addition to the cancer registry of anyone dying from cancer as recorded by the

death registrations. In the United Kingdom the proportion of cancer registrations that are diagnosed by death certification only (DCOs) is used as a quality measure of the coverage of the cancer registry. A low proportion of DCOs indicates that the registry is very good at searching out all incidences of cancer. The Cyprus cancer registry does not routinely receive notifications of deaths from cancer from the deaths registry and there is therefore a potential gap in the enumeration of cancer incidence.

For this study we are interested in counting the incidence of new primary cancer cases. If a patient is suffering from two independent primary cancers then they should be counted twice. The desired numerator to count is therefore registrations of primary cancers and not cancer patients. At first glance, therefore, the fact that the cancer registry is a simple list of cancer registrations and does not attempt to link multiple registrations for the same individual patients, would not appear to be a problem. However, as discussed in the data quality section above it becomes a necessary exercise if one is to eliminate duplicate records and also to determine whether a new cancer registration is of a new primary cancer or of a secondary cancer that has occurred as the sequel of an existing registered primary cancer. We have attempted to link registrations using personal identifiers and whilst this has enabled us to remove some duplicate records we have been unable to identify secondary cancers. All the registrations are therefore treated as primary cancers, which means that there may be some over-estimation of rates.

The linkage of registrations to patients becomes even more important should the registry wish, in future, to link to other sources of data on treatment and outcome such as hospital records and death registrations. Such linkage would then allow routine analysis of the treatment outcomes and survival of cancer patients.

The exercise to allocate Quarter codes to the Lakatamia Municipality registrations showed some inaccuracies exist in the allocation of the area of residence codes. Seven registrations were found to be resident in Strovolos Municipality. A certain amount of geographical inaccuracy is to be expected and, provided such errors are randomly distributed, should not affect the analysis unduly. Systematic errors such as the inclusion of the Anthoupolis Refugee Housing Estate within Lakatamia Municipality will result in biased results if they are not corrected for within the analysis.

5.5.4 Analysis

For the analyses only those non-duplicate registrations with complete age, sex, diagnosis and 4-digit area of permanent residence data were used. There were 7,773 such registrations, representing 93.6% of the original 8307 registrations listed.

A summary of the analysis of the cancer registrations is given below with selected tables and figures. The full set of tables and figures including separate tables for males and females (where appropriate) can be found in Appendix 1.

Table 5.13 shows a breakdown of the proportion of cancer registrations by type of cancer for Cyprus, Lefkosia District, Lakatamia Municipality and the index Quarter of Ayia Paraskevi. This is a crude comparison and does not take into the different age structures of the areas being compared but it does suggest that none of the listed types of cancer shows an abnormal frequency in Lakatamia or the main index Quarter of Ayia Paraskevi.

1) All Cancers

Table 5.14 shows the cancer registration rates for all cancers for Cyprus, Lefkosia District, selected Municipalities in and around Lefkosia City, Lakatamia Municipality and the Quarters of Lakatamia. The table suggests that cancer registration for Lakatamia Municipality is approximately 19% higher than expected from the average Cyprus rates (ISR = 188.8, 95%CI: 105.7-133.0). The funnel plot (Figure 5.5) shows that this excess is statistically significantly different from the expected ratio at the 95% confidence level but it still within the 99.8% confidence control limits and may therefore be considered as being 'in-control'. It can also be seen from Table 5.14 and graphically in Figure 5.6 that although the Lakatamia Municipality cancer registration ratio is high compared to Cyprus, it is not unusually high when compared to the other Municipalities in and around Lefkosia, falling approximately in the middle of the distribution. The overlapping confidence intervals suggest that the ratio is not statistically significantly different from that of any of the other Municipalities listed.

The table and funnel plot also show the ratios for the four Quarters of Lakatamia. The highest ratio is in Ayios Mammas (ISR=176.7 95%CI: 123.7-244.6) and is statistically significantly high but still within the control limits of the expected variation. Ayios Nicolaos, Archangelos-Anthoupolis and Ayia Paraskevi have ratios that are not statistically significantly different from those expected. There is no evidence of an overall excess of cancer registrations in Ayia Paraskevi.

Similar patterns are seen for male and female registrations.

2) Stomach Cancer

Registrations of stomach cancer were low with only 278 records for the whole of Cyprus Government controlled area during the period. Of these 9 were resident in Lakatamia municipality. Given the small numbers involved the precision in the registration rates and ratios is low and the confidence intervals are wide. It is very difficult to determine real differences from random variation. Figure 5.7 shows the funnel plot for the indirectly standardised stomach cancer registration ratios for persons. It can be seen that the ratios for Lakatamia Municipality and all four of its Quarters were within the control limits of the expected random variation. The Ayios Mammas ratio was high but not out-of-control (ISR=407.1, 95%CI: 81.8-1189.5).

3) Colorectal Cancer

Figure 5.8 shows the funnel plot for the indirectly standardised colorectal cancer registration ratios for persons. As for stomach cancer, the Municipality and four Quarters of Lakatamia all have ratios that are within the 99.8% confidence limits and can be considered to be in-control. This time the highest ratio was in Archangelos-Anthoupolis (ISR=140.6, 95%CI: 72.6-245.7) and the lowest in Ayia Paraskevi (ISR=49.1, 95%CI: 17.9-106.8). In the case of Ayia Paraskevi the difference from the expected ratio was statistically significant at the 95% confidence level.

4) Lung Cancer

Lung cancer registration ratios are shown in Figure 5.9. Ratios for Lakatamia Municipality and all four of its Quarters are within the control limits of the expected variation. None are statistically different from the expected ratios at the 95% confidence level. Ayios Mammas has the highest ratio (ISR=162.4, 95%CI: 32.6-474.5) and Ayios Nicolaos the lowest (ISR=34.7, 95%CI: 0.5-192.8). The ratio for Lakatamia Municipality is comparable to those of the other Municipalities in and around Lefkosia city (ISR=132.8, 95%CI: 87.5-193.3).

5) Breast Cancer

Figure 5.10 shows that the indirectly standardised ratios for Lakatamia Municipality and all four of its Quarters are not statistically significantly different from those expected. At the Quarter level, the ratio was highest in Ayios Mammas (ISR=247.7, 95%CI 113.0-470.3) and lowest in Ayios Nicolaos (ISR=69.4, 95%CI: 22.4-161.9).

6) Cancer of the Uterus (any part)

The overall ratio for Lakatamia was higher than expected (ISR=145.1, 95%CI: 85.9-229.3) but not statistically significantly so, being well within the control limits (Figure 5.11). Within Lakatamia, the ratio was highest in Ayios Mammas (ISR=836.3, 95%CI: 103.9-988.9) and lowest in Ayios Nicolaos where no cancers of the uterus were observed. The ratio for none of the Quarters was statistically significantly different from that expected.

7) Cancer of the Prostate

Ratios for the four Quarters of Lakatamia are all higher than expected (Table 5.15). However, the number of registrations is small resulting in wide confidence intervals in the estimates and all four are all within the control limits of the funnel plot (Figure 5.12). Ayios Nicolaos (ISR=348.7, 95%CI: 180.0-609.2) has the highest ratio and Ayia Paraskevi (ISR=108.6, 95%CI: 56.1-189.7) the lowest ratio of the four Quarters. The overall ratio for Lakatamia Municipality (ISR=186.2, 95%CI: 136.3-248.4) is significantly high and outside the control limits. The ratios are high for most of the comparator Municipalities, and their confidence intervals overlap that of Lakatamia (Figure 5.13).

8) Cancer of the Urinary Tract

Figure 5.14 shows the funnel plot for the indirectly standardised registration ratios for cancers of the urinary tract. Ratios for all four Quarters and the Lakatamia Municipality as a

whole are well within control limits. Indeed, the ratio for none of the areas is statistically significantly different from the expected. The highest ratio observed was in Archangelos-Anthoupolis (ISR=126.5, 95%CI: 57.7-240.2) and the lowest in Ayios Mammas (ISR=53.3, 95%CI: 0.7-296.8).

9) Cancers of the Lymphoid, Haematopoietic and Related Tissue

Figure 5.15 shows the funnel plot for the indirectly standardised registration ratios for cancers of the lymphoid, haematopoietic and related tissue. Ratios for all four Quarters and the Lakatamia Municipality as a whole are well within control limits and are not statistically significantly different from those expected. The highest ratio observed was in Ayia Paraskevi (ISR=115.9, 95%CI: 59.8-202.5) and the lowest in Ayios Nicolaos (ISR=57.5, 95%CI: 6.5-207.5).

5.5.5 Conclusions

1. The main index Quarter of Ayia Paraskevi did not show unusually high levels of registrations for any of the specific cancers considered nor all cancers in general.

2. The secondary index Quarter of Ayios Mammas has consistently high ratios for most of the specific cancers considered and all cancers in general. The ratio, however, never fell outside of the control limit of that expected. It should be remembered also that the control limits account only for random variation in the cancer registration ratio and do not include any further legitimate variation as a result of other factors such as deprivation. Ayios Mammas has particularly unusual socio-economic characteristics, being much more deprived than average, and may therefore be expected to have high ratios. It also has a particularly old age-structure, which may not be adjusted for sufficiently in the constructed of the age-standardise rates and ratios (it would be preferable to break the upper age band of 75+ into finer bands).

3. The overall level of cancer registrations for Lakatamia Municipality as a whole was high compared to the Cyprus average but not unusual compared to the comparator Municipalities in and around Lefkosia. The only specific cancer for which Lakatamia was outside of expected control limits was prostate cancer. This was due to high ratios in Archangelos-Anthoupolis, Ayios Mammas and Ayios Nicolaos. The prostate cancer ratio in Ayia Paraskevi was not unusual.

4. In conclusion the cancer registration data do **not** provide evidence of any unusual excess of cancer incidence that might be due to some special cause in the Ayia Paraskevi Quarter.

5.5.6 Recommendations

The recommendations below are made with a view to improving the Cyprus cancer registry as a source of data for routine and ad-hoc epidemiological analyses such as this.

1. Registrations should be linked for individual patients to identify potential duplicate records and multiple registrations.
2. Differentiation should be made between registrations of primary and secondary cancers.
3. Morphology and Topography data should be used to routinely generate and ICD10 cancer diagnosis code.
4. Registrations of deaths from cancer should be linked to the cancer registrations to improve coverage and provide the potential for routine analysis of cancer survival. The success of such linkage will depend on improvements to recording of cause of death and the quality of recording the data items needed to match individuals (i.e. personal identifiers such as national Identification Number, name, sex, date of birth, address etc).
5. Efforts should be made to continue and improve the high level of area of residence coding, in particular to ensure that their geographical coding is as accurate as possible and reflects the official Municipality/Community/Quarter definitions. Anthoupolis Refugee Housing Estate should be treated as separate Community to Lakatamia Municipality. The Registry should instigate routine coding of the 6-digit Quarter where appropriate.

Table 5.8
Cancer Registrations By District and Year of Registration
Cyprus, Registered 1998-2002

Hospital	Year of Discharge					Total 1998-2002
	1998	1999	2000	2001	2002	
1 LEFKOSIA DISTRICT	674	678	752	693	761	3,558
3 AMMOCHOSTOS DISTRICT	60	59	61	82	91	353
4 LARNACA DISTRICT	224	215	225	237	299	1,200
5 LEMESOS DISTRICT	395	419	430	420	482	2,146
6 PAFOS DISTRICT	117	121	129	143	141	651
Unspecified	102	80	88	89	40	399
Cyprus (Government Controlled)	1,572	1,572	1,685	1,664	1,814	8,307

Source: Ministry of Health

Table 5.9
Cancer Registrations
Duplicate Identification Numbers
Cyprus, Registered 1998-2002

Duplicate ID Match Type	Duplicate Pairs
Same individual - duplicate registration	13
Same individual - multiple registration	57
Different individuals	18
Undetermined match type	9
Total All Duplicate ID Pairs	97

Source: Ministry of Health

Table 5.10
Cancer Registrations Missing Key Data Items By Year of Registration
Cyprus, Registered 1998-2002

Year	All Registrations	Registrations With Missing:							
		Sex		Age		Area of Residence		Diagnosis	
		No	%	No	%	No	%	No	%
1998	1,572	0	*0.0%*	57	*3.6%*	105	*6.7%*	0	*0.0%*
1999	1,572	0	*0.0%*	27	*1.7%*	88	*5.6%*	0	*0.0%*
2000	1,685	0	*0.0%*	21	*1.2%*	101	*6.0%*	0	*0.0%*
2001	1,664	0	*0.0%*	21	*1.3%*	94	*5.6%*	0	*0.0%*
2002	1,814	0	*0.0%*	23	*1.3%*	49	*2.7%*	0	*0.0%*
1998-2002	8,307	0	*0.0%*	149	*1.8%*	437	*5.3%*	0	*0.0%*

Source: Ministry of Finance

Table 5.11
Cancer Registrations Missing Place of Permanent Residence Code
By Selected Hospital/Clinic[1]
Cyprus, Registered 1998-2002

Hospital Clinic	All Registrations	Registrations With Missing Area of Residence	
		No	%
Oncologiko Kentro Tr. Kyprou, Lefkosia	3,306	21	*0.6%*
Lefkosia General Hospital	2,600	82	*3.2%*
Lemesos Hospital	488	10	*2.0%*
Makario Nosokomio Lefkosia	440	15	*3.4%*
Larnaca Hospital	265	144	*54.3%*
Polyklinik Ygia, Lemesos	191	7	*3.7%*
Ippokratio Iatriko Kentro, Lefkosia	113	1	*0.9%*
Apollonion Idiotiko Nosokomio, Lefkosia	90	15	*16.7%*
Paphos Hospital	87	10	*11.5%*

Source: Ministry of Finance

1 - All hospitals and clinics with 50 or more registrations during 1998-2002.

Table 5.12
Cancer Registrations By Quarter of Residence
Lakatamia Municipality, Registered 1998-2002

Quarter as derived from the street address recorded for cancer registrations assigned to Lakatamia Municipality		Registrations		
		No	*% of Original Lakatamia Total*	*% of Revised Lakatamia Total*
102101	Ayios Mammas	36	*10.6%*	*12.0%*
102102	Ayia Paraskevi	116	*34.2%*	*38.5%*
102103	Archangelos- Anthoupolis	97	*28.6%*	*32.2%*
102104	Ayios Nicolaos	39	*11.5%*	*13.0%*
	Undetermined Quarter	13	*3.8%*	*4.3%*
1021	Lakatamia Municipality	301	*88.8%*	*100.0%*
1012	Strovolos Municipality	7	*2.1%*	
1021	Anthoupolis Refugee Housing Estate	31	*9.1%*	
1021	Total originally assigned to Lakatamia Municipality	339	*100.0%*	

Source: Ministry of Health

Table 5.13
Cancer Registrations By Type Of Cancer
Cyprus (Government Controlled), Lefkosia District, Lakatamia Municipality and Ayia Paraskevi Quarter
Registered 1998-2002

Cancer	Cyprus (Government Controlled)		Lefkosia District		Lakatamia Municipality		Ayia Paraskevi Quarter	
	No	%	No	%	No	%	No	%
Stomach Cancer (ICD10 C16)	278	*3.6%*	111	*3.1%*	9	*3.0%*	3	*2.6%*
Colorectal Cancer (ICD10 C18-C20)	892	*11.5%*	396	*11.2%*	27	*9.0%*	6	*5.2%*
Lung Cancer (ICD10 C34)	673	*8.7%*	308	*8.7%*	27	*9.0%*	14	*12.1%*
Breast Cancer (ICD10 C50)	1,442	*18.6%*	646	*18.3%*	59	*19.6%*	25	*21.6%*
Uterus (Any Part) (ICD10 C53-C55)	382	*4.9%*	173	*4.9%*	18	*6.0%*	6	*5.2%*
Cancer of the Prostate (ICD10 C61)	878	*11.3%*	483	*13.7%*	47	*15.6%*	12	*10.3%*
Cancers of the Urinary Tract (ICD10 C64-C68)	699	*9.0%*	284	*8.0%*	24	*8.0%*	11	*9.5%*
Cancers of the Lymphoid, Haematopoietic and Related Tissue (ICD10 C81-C96)	677	*8.7%*	295	*8.3%*	25	*8.3%*	12	*10.3%*
Other Cancers	1,852	*23.8%*	840	*23.8%*	65	*21.6%*	27	*23.3%*
Total All Cancers	7,773	*100.0%*	3,536	*100.0%*	301	*100.0%*	116	*100.0%*

Source: Ministry of Health

Table 5.14
Cancer Registrations for All Cancers
Crude Rate, Directly Standardised Rates, and Indirectly Standardised Ratios
By District and Selected Municipalities/Communities/Quarters
Cyprus, Persons, Registered 1998-2002

Area		Count	Crude Rate[1]	DSR[1, 2]		Standardised Ratio[4]	
				Rate	*95% CI*[3]	Ratio	*95% CI*[3]
0	Cyprus (Government Controlled)	7773	225.4	227.4	*216.4 - 239.1*	100.0	*97.8 - 102.2*
1	LEFKOSIA DISTRICT	3525	257.6	256.2	*237.9 - 276.0*	113.3	*109.6 - 117.1*
3	AMMOCHOSTOS DISTRICT	316	167.5	193.1	*150.7 - 247.5*	86.2	*76.9 - 96.2*
4	LARNACA DISTRICT	1187	206.0	216.3	*190.3 - 245.9*	94.5	*89.2 - 100.1*
5	LEMESOS DISTRICT	2108	216.7	223.8	*203.4 - 246.1*	100.3	*96.0 - 104.7*
6	PAFOS DISTRICT	637	192.0	186.1	*156.2 - 221.8*	80.8	*74.7 - 87.4*
1000	Lefkosia Municipality	822	343.7	298.3	*255.3 - 348.4*	133.4	*124.4 - 142.8*
1010	Ayios Dometios Municipality	210	346.4	282.9	*208.1 - 384.4*	126.2	*109.7 - 144.5*
1011	Egkomi Municipality	171	250.7	299.1	*213.5 - 419.1*	126.8	*108.5 - 147.3*
1012	Strovolos Municipality	784	267.9	275.4	*235.5 - 321.9*	120.2	*111.9 - 128.9*
1013	Aglantzia Municipality-Aglangia	243	256.4	252.4	*190.5 - 334.2*	110.8	*97.3 - 125.6*
1021	**Lakatamia Municipality**	**299**	**210.0**	**265.4**	***204.1 - 345.0***	**118.8**	***105.7 - 133.0***
1022	Anthoupolis Refugee Housing Est.	31	248.8	153.6	*65.8 - 358.7*	65.9	*44.8 - 93.5*
1023	Latsia Municipality (Lakkia)	141	231.2	254.1	*175.4 - 368.1*	113.7	*95.7 - 134.1*
1024	Geri	52	161.4	231.5	*121.6 - 440.8*	101.3	*75.6 - 132.8*
102101	Ayios Mammas	36	628.8	458.3	*203.7 - 1030.9*	176.7	*123.7 - 244.6*
102102	Ayia Paraskevi	115	195.0	228.1	*150.2 - 346.5*	102.9	*84.9 - 123.5*
102103	Archangelos- Anthoupolis	95	168.1	262.9	*160.7 - 430.1*	113.8	*92.0 - 139.1*
102104	Ayios Nicolaos	37	174.6	216.7	*102.2 - 459.3*	102.6	*72.2 - 141.4*

Source: Ministry of Health

1 - Crude rates and DSRs are expressed per 100,000 population per year
2 - DSRs use the European Standard Population.
3 - 95% confidence interval

4 - Indirectly Standardised Ratios use Cyprus (Government Controlled) rates as the standard.

Table 5.15
Cancer Registrations for Prostate Cancer (ICD10 C61)
Crude Rate, Directly Standardised Rates and Indirectly Standardised Ratios
By District and Selected Municipalities/Communities/Quarters
Cyprus, Males, Registered 1998-2002

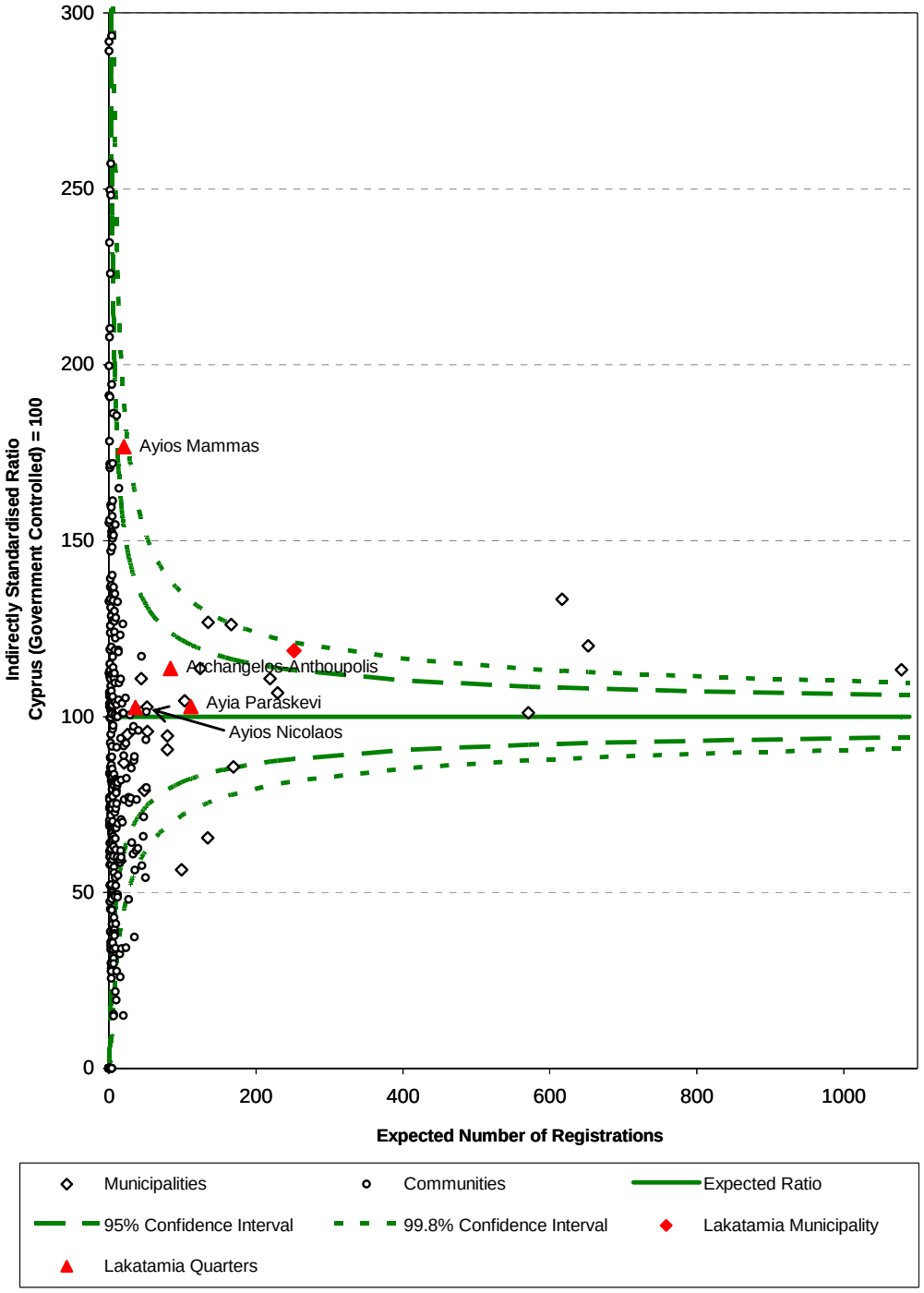
Area		Count	Crude Rate[1]	DSR[1, 2]		Standardised Ratio[4]	
				Rate	*95% CI[3]*	Ratio	*95% CI[3]*
0	Cyprus (Government Controlled)	878	51.9	54.0	*46.6 - 62.7*	100.0	*93.5 - 106.8*
1	LEFKOSIA DISTRICT	481	72.0	75.2	*61.6 - 91.9*	138.5	*126.4 - 151.5*
3	AMMOCHOSTOS DISTRICT	23	24.1	31.1	*12.5 - 77.4*	58.0	*36.8 - 87.0*
4	LARNAKA DISTRICT	90	31.7	34.1	*21.4 - 54.2*	63.2	*50.8 - 77.6*
5	LEMESOS DISTRICT	219	46.7	62.2	*45.9 - 84.2*	106.5	*92.8 - 121.5*
6	PAFOS DISTRICT	65	39.2	36.8	*21.3 - 63.7*	69.4	*53.6 - 88.5*
1000	Lefkosia Municipality	109	94.9	82.6	*54.0 - 126.4*	152.8	*125.5 - 184.4*
1010	Ayios Dometios Municipality	22	75.5	55.3	*21.7 - 140.8*	108.6	*68.0 - 164.4*
1011	Egkomi Municipality	22	66.8	84.9	*33.4 - 216.2*	156.5	*98.0 - 236.9*
1012	Strovolos Municipality	114	80.5	87.1	*57.8 - 131.2*	161.9	*133.5 - 194.5*
1013	Aglantzia Municipality-Aglangia	34	74.2	78.8	*37.0 - 167.8*	147.2	*102.0 - 205.8*
1021	**Lakatamia Municipality**	**46**	**66.1**	**100.0**	***51.5 - 194.1***	**186.2**	***136.3 - 248.4***
1022	Anthoupolis Refugee Housing Est.	2	33.9	16.4	*0.7 - 363.6*	33.3	*3.7 - 120.2*
1023	Latsia Municipality (Lakkia)	16	53.7	68.6	*22.9 - 205.6*	126.2	*72.1 - 204.9*
1024	Geri	5	31.2	61.9	*8.5 - 453.3*	108.6	*35.0 - 253.5*
102101	Ayios Mammas	5	186.2	106.7	*14.8 - 766.7*	197.1	*63.5 - 460.1*
102102	Ayia Paraskevi	12	41.2	59.7	*16.4 - 216.7*	108.6	*56.1 - 189.7*
102103	Archangelos- Anthoupolis	14	51.3	99.5	*29.1 - 339.9*	182.4	*99.6 - 306.1*
102104	Ayios Nicolaos	12	114.2	178.1	*47.9 - 661.3*	348.7	*180.0 - 609.2*

Source: Ministry of Health

1 - Crude rates and DSRs are expressed per 100,000 population per year
2 - DSRs use the European Standard Population.
3 - 95% confidence interval
4 - Indirectly Standardised Ratios use Cyprus (Government Controlled) rates as the standard.

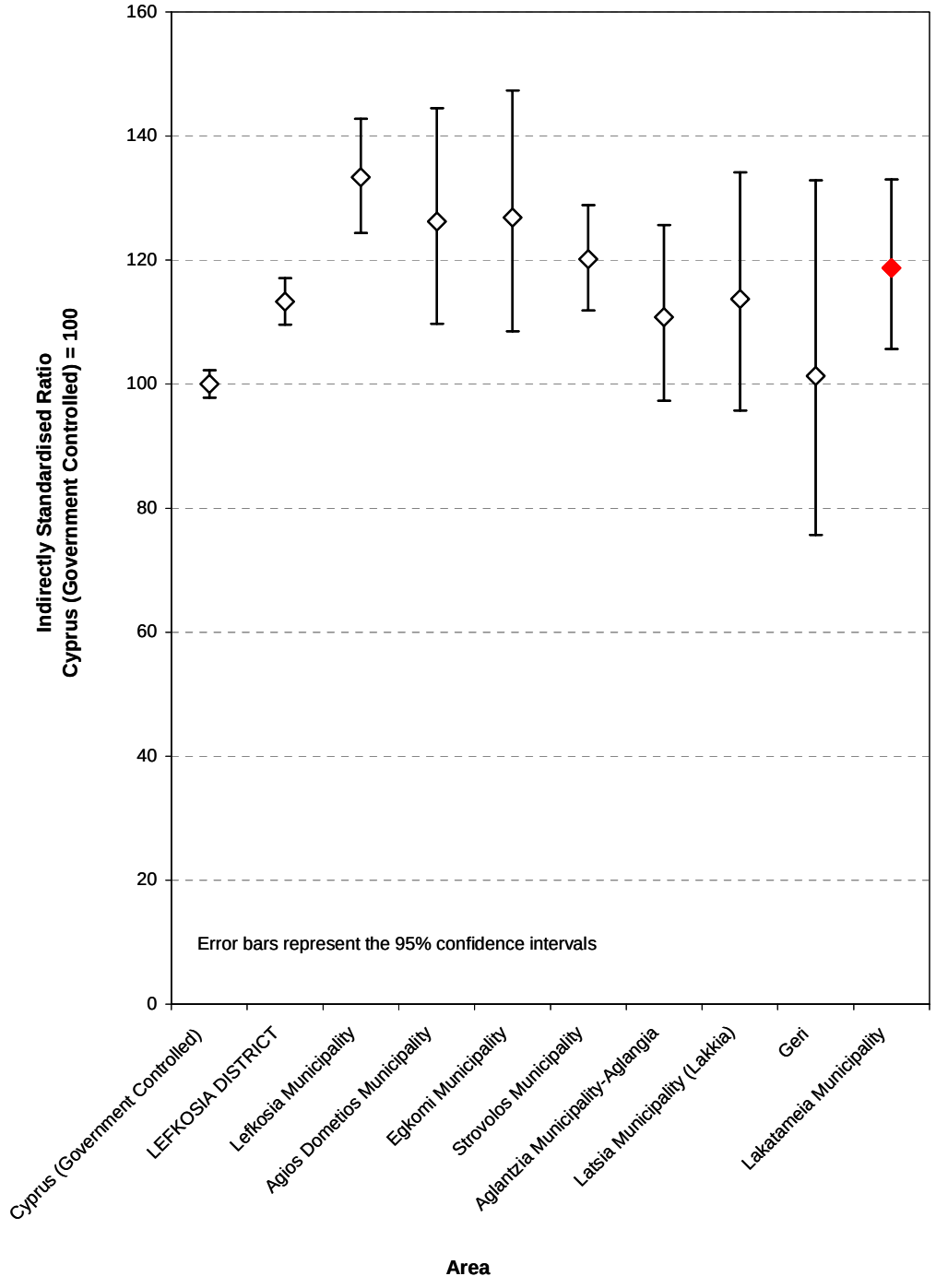
Figure 5.5

Cancer Registrations for All Cancers
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Persons, Registered 1998-2002



Source: Ministry of Health

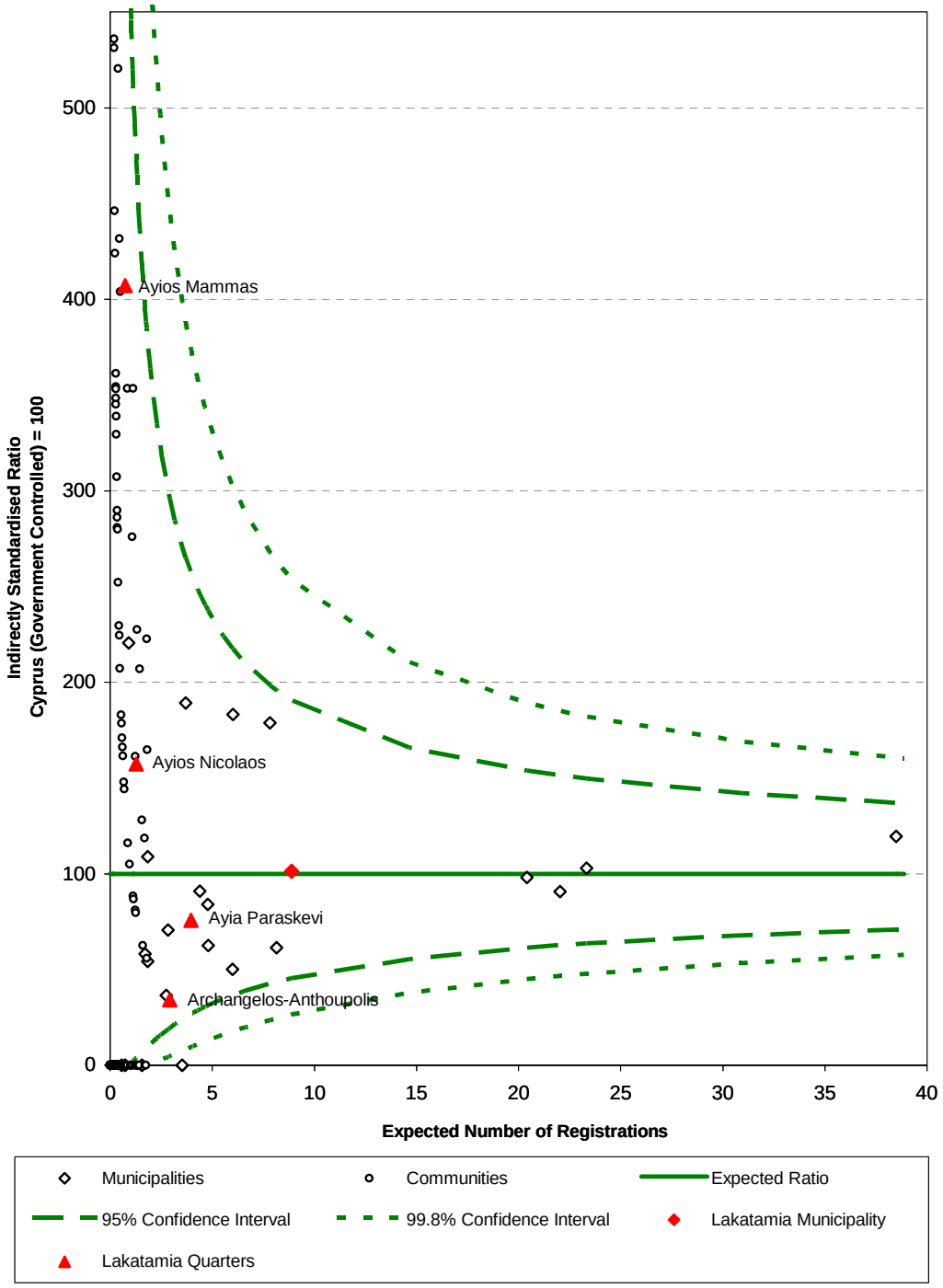
Figure 5.6
Cancer Registrations for All Cancers
Indirectly Standardised Ratios by Selected District/Municipality/Community
Cyprus, Persons, Registered 1998-2002



Source: Ministry of Health

Figure 5.7

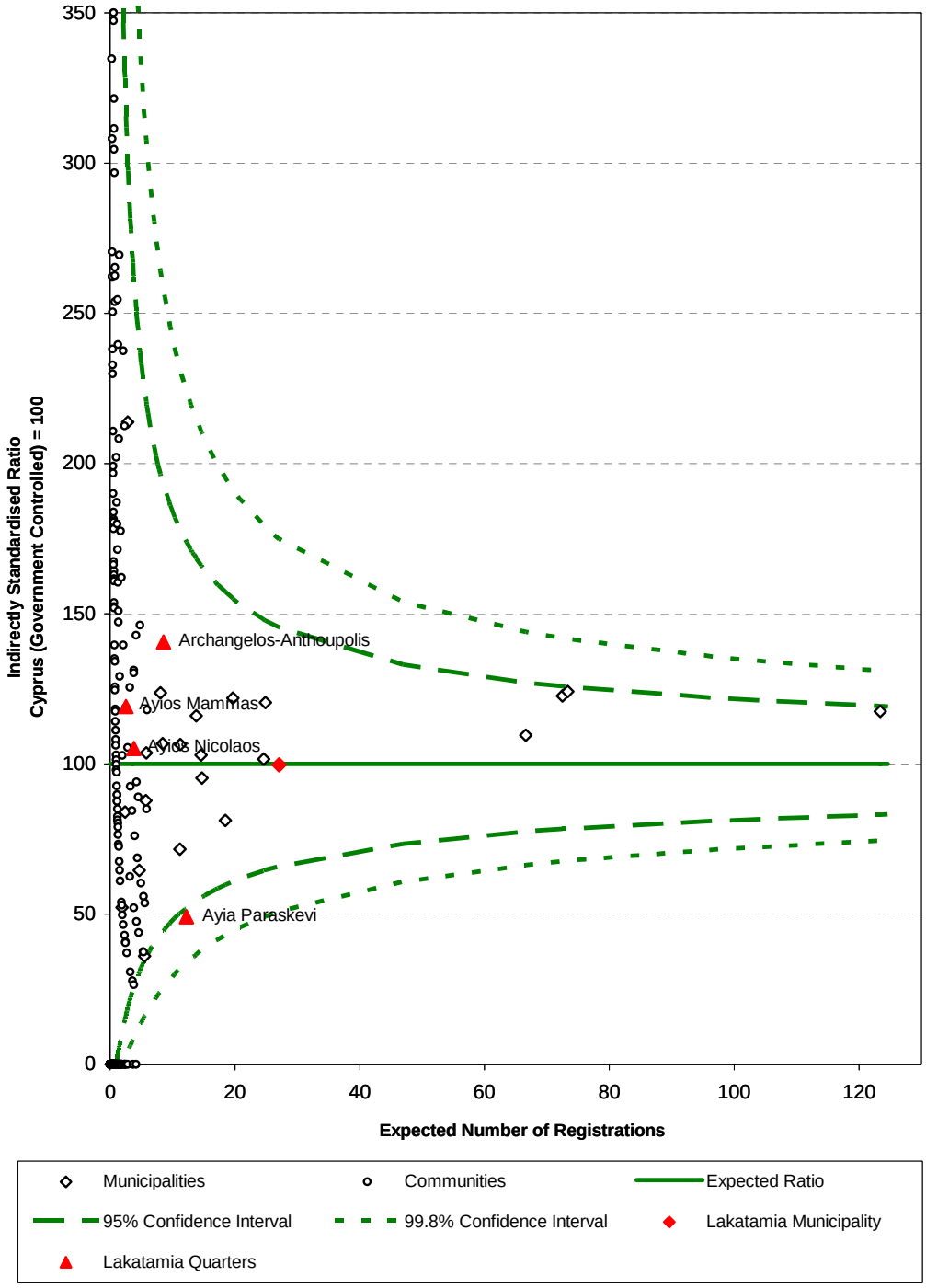
Cancer Registrations for Stomach Cancer (ICD10 C16)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Persons, Registered 1998-2002



Source: Ministry of Health

Figure 5.8

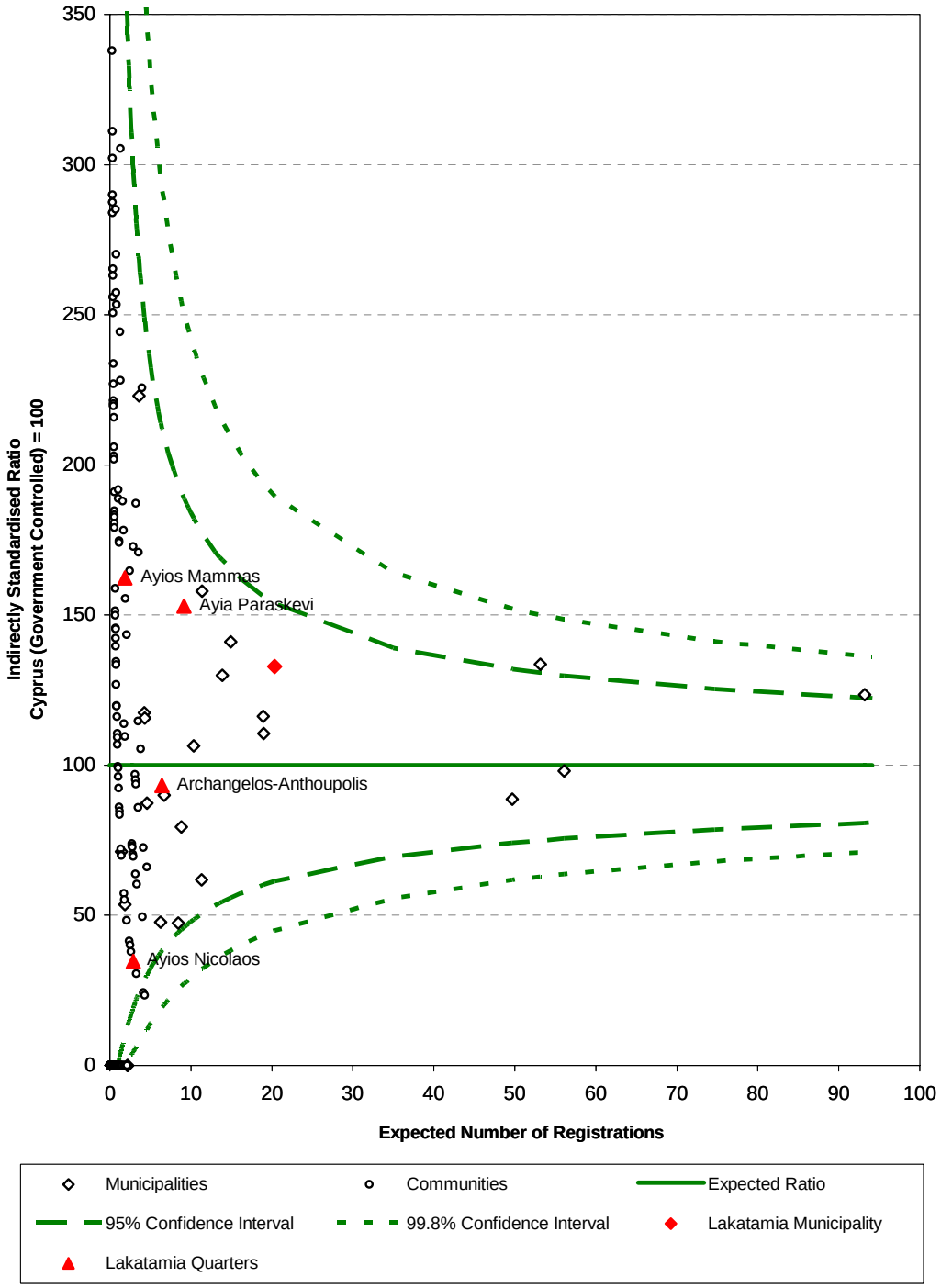
Cancer Registrations for Colorectal Cancer (ICD10 C18-C20)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Persons, Registered 1998-2002



Source: Ministry of Health

Figure 5.9

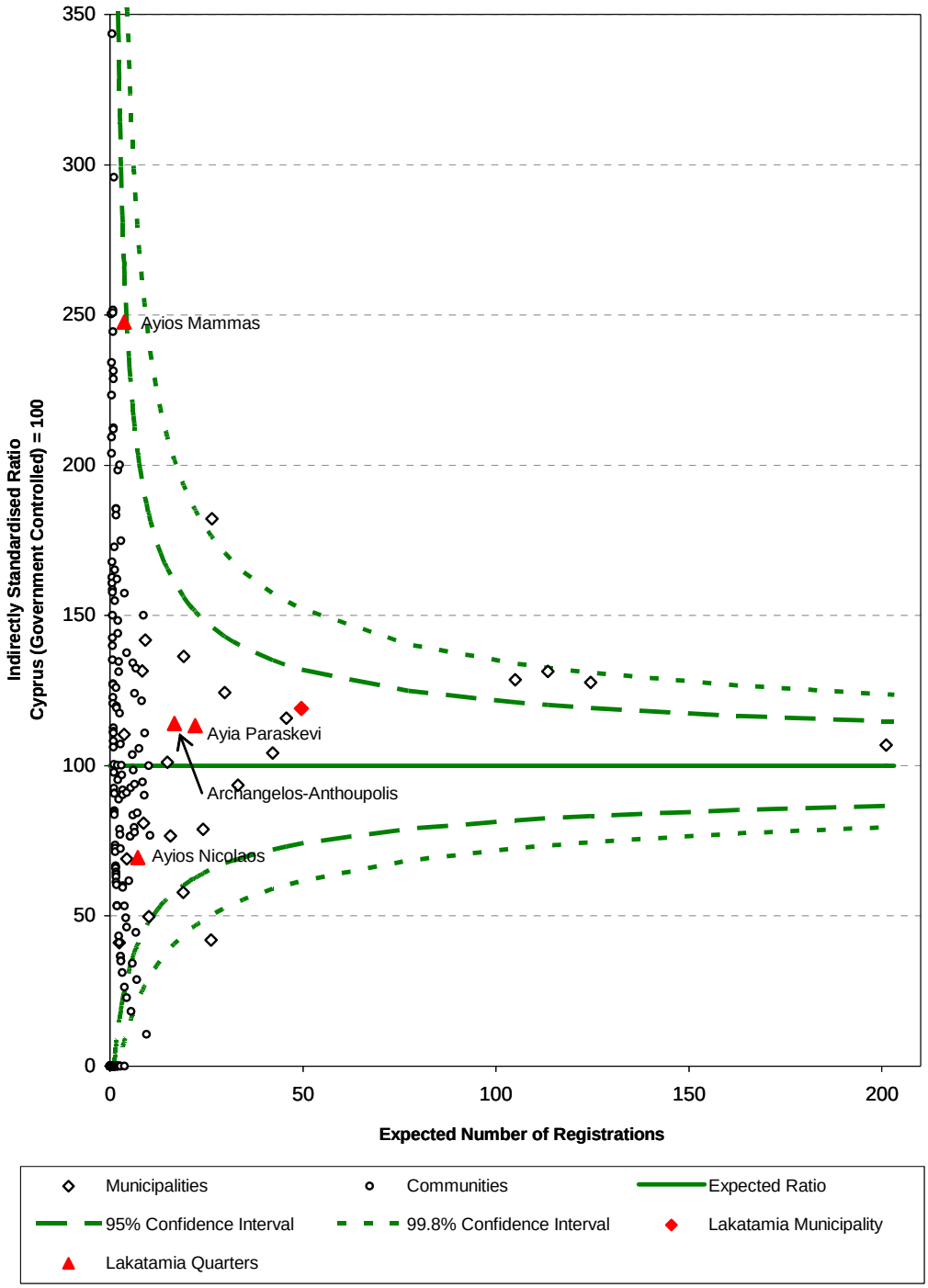
Cancer Registrations for Lung Cancer (ICD10 C33-C34)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Persons, Registered 1998-2002



Source: Ministry of Health

Figure 5.10

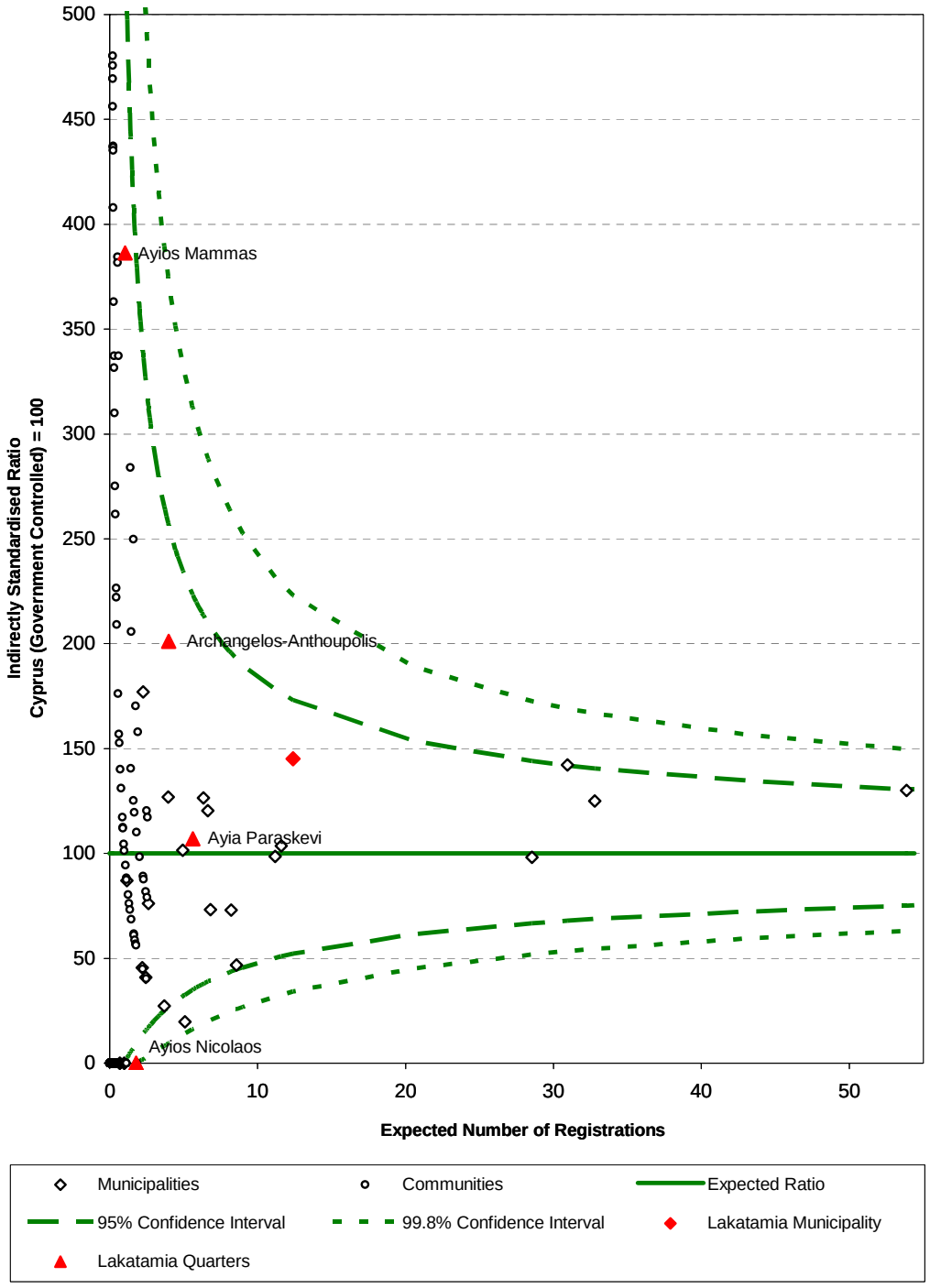
Cancer Registrations for Breast Cancer (ICD10 C50)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Females, Registered 1998-2002



Source: Ministry of Health

Figure 5.11

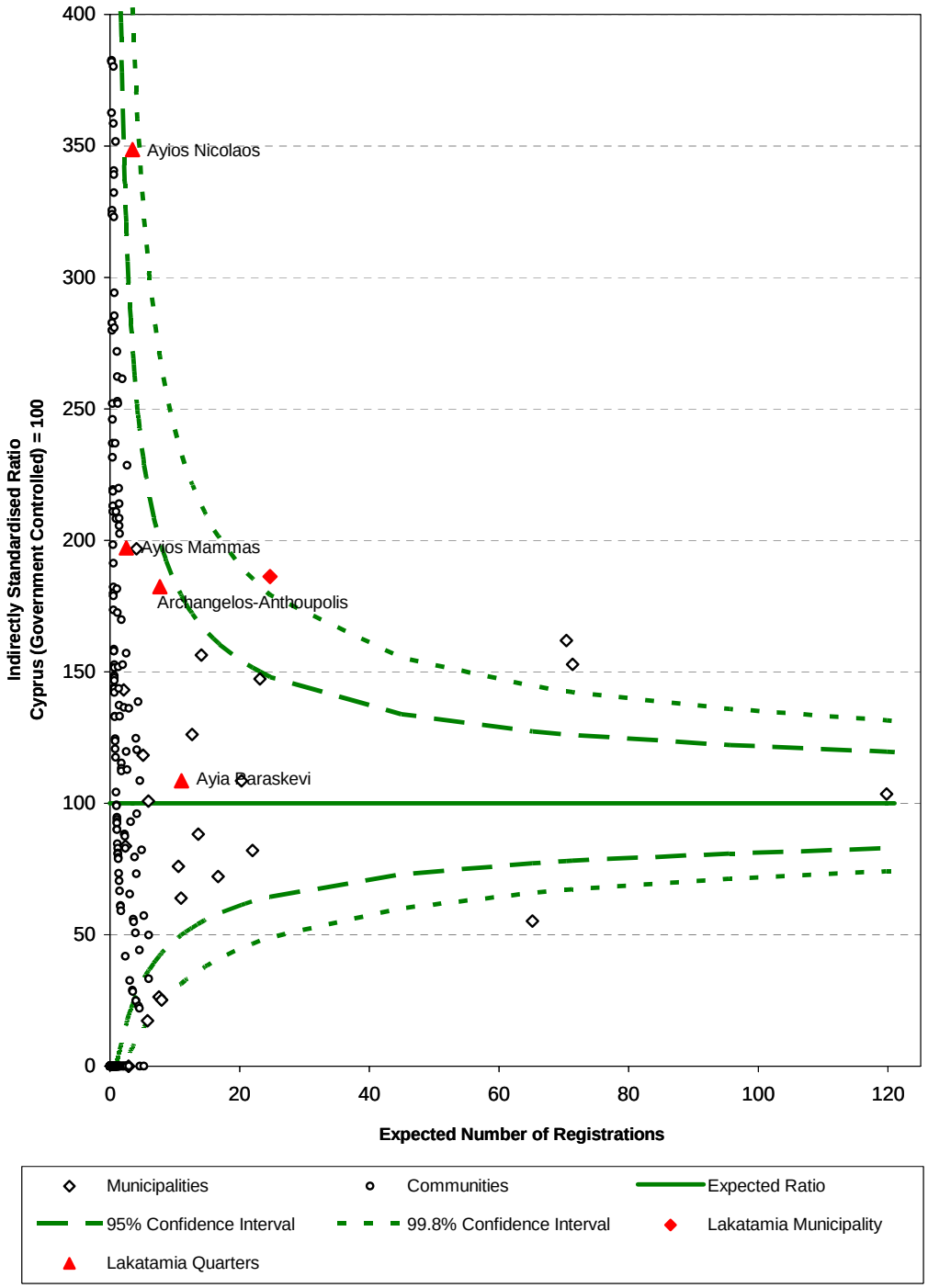
Cancer Registrations for Cancer of the Uterus (Any Part) (ICD10 C53-C55)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Females, Registered 1998-2002



Source: Ministry of Health

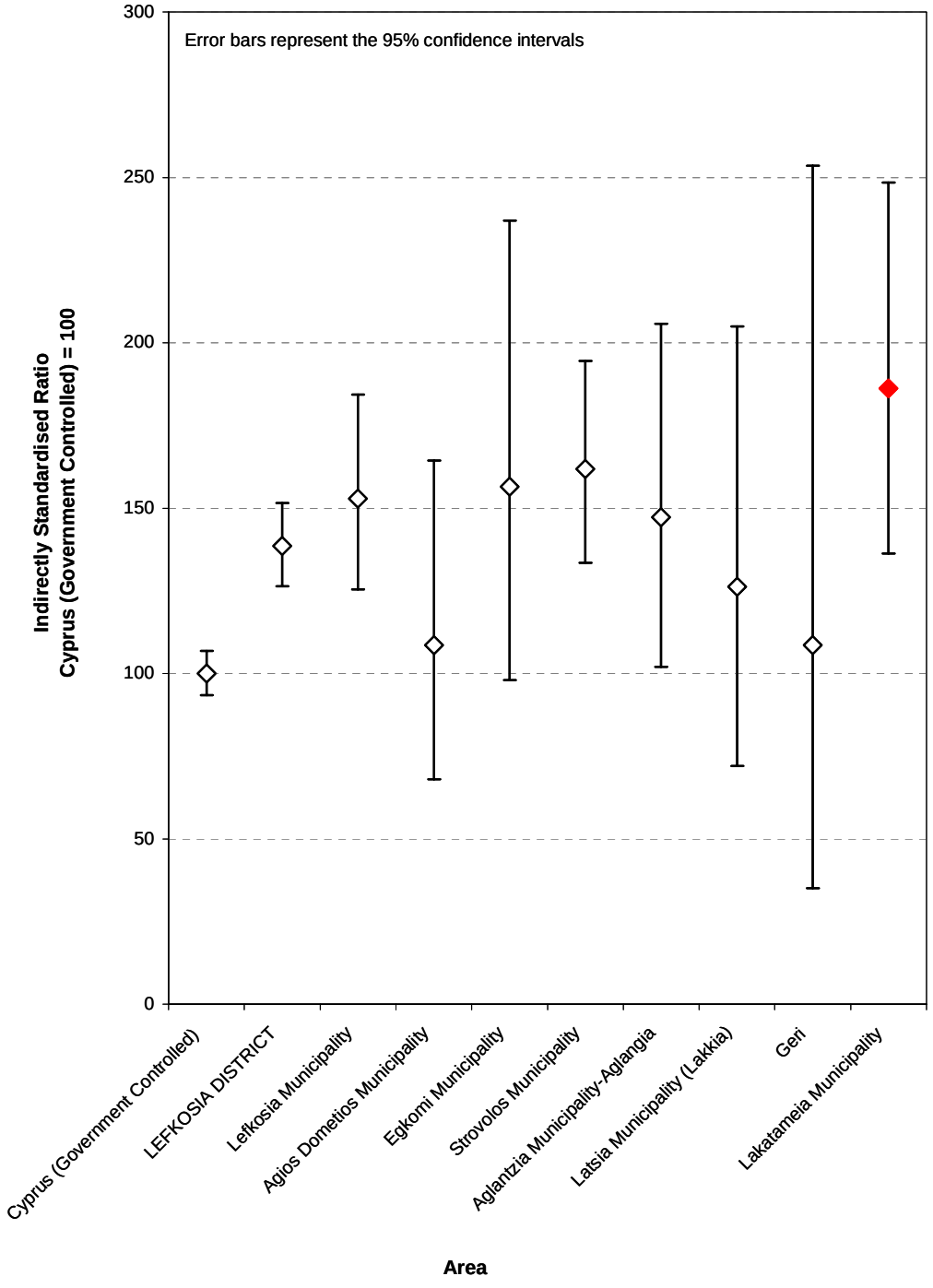
Figure 5.12

Cancer Registrations for Prostate Cancer (ICD10 C61)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Males, Registered 1998-2002



Source: Ministry of Health

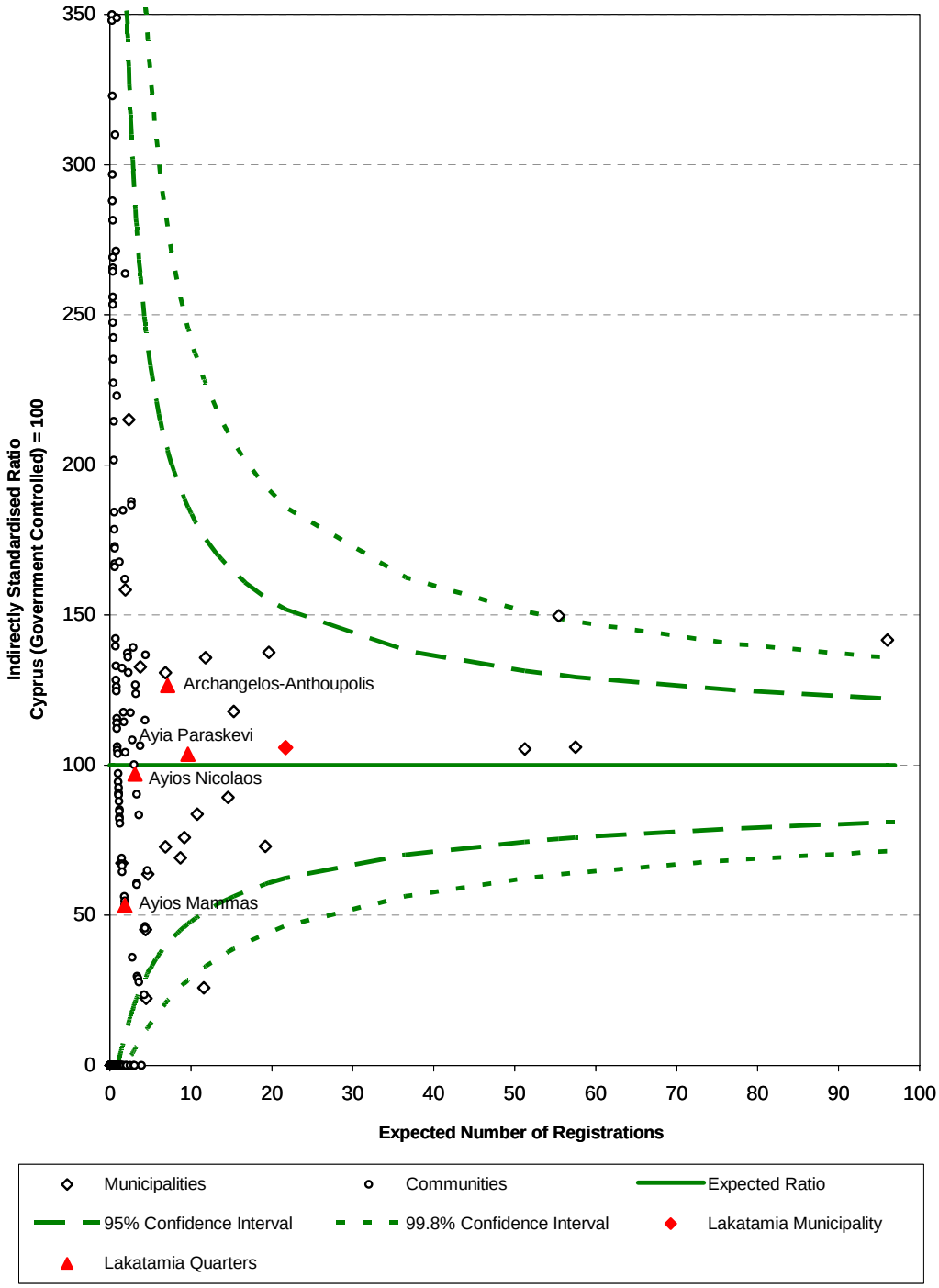
Figure 5.13
Cancer Registrations for Prostate Cancer (ICD10 C61)
Indirectly Standardised Ratios by Selected District/Municipality/Community
Cyprus, Males, Registered 1998-2002



Source: Ministry of Health

Figure 5.14

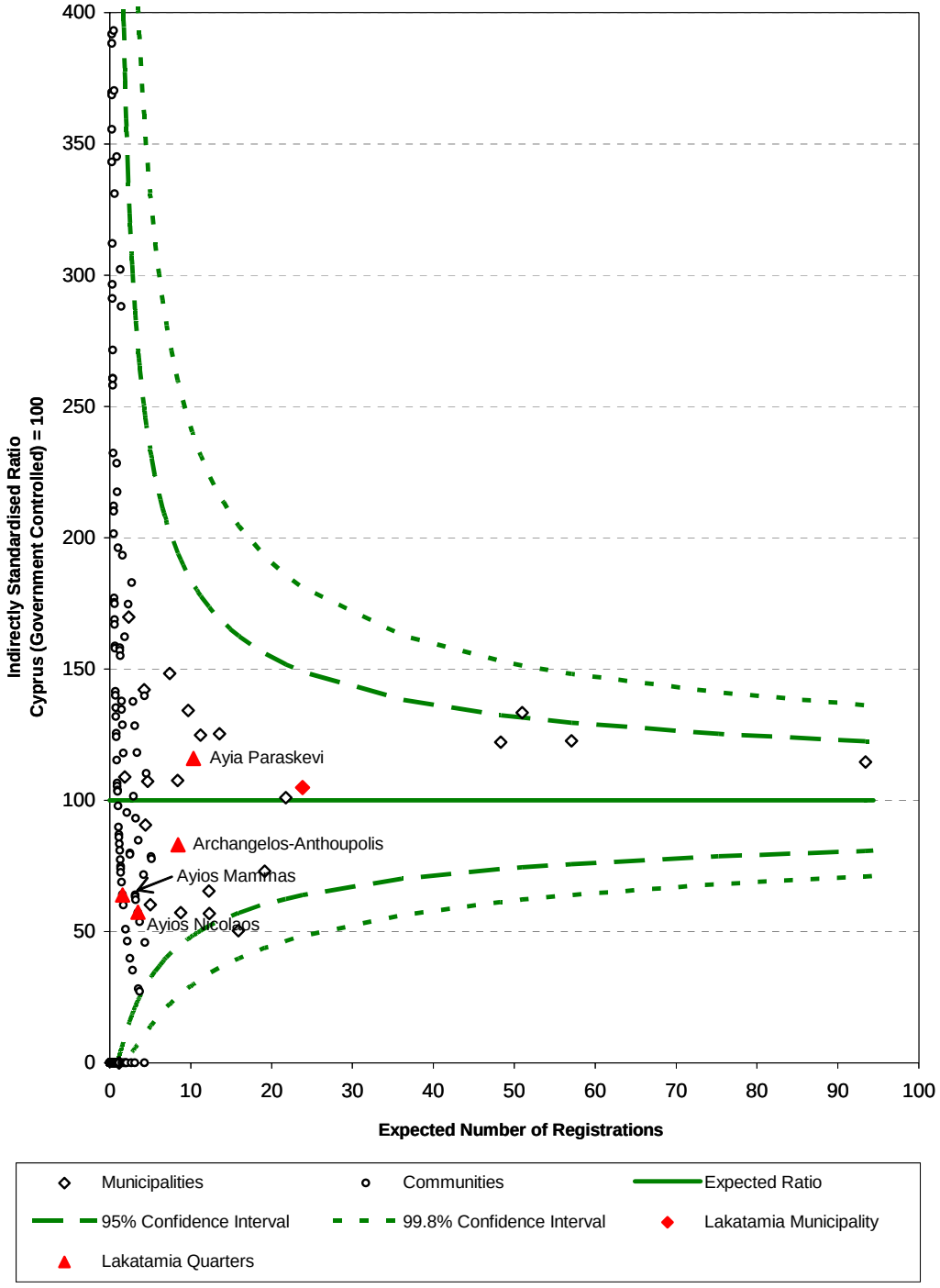
Cancer Registrations for All Cancers of the Urinary Tract (ICD10 C64-C68)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Persons, Registered 1998-2002



Source: Ministry of Health

Figure 5.15

Cancer Registrations for Cancers of the Lymphoid, Haematopoietic and Related Tissue (ICD10 C81-C96)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community/Quarter
Cyprus, Persons, Registered 1998-2002



Source: Ministry of Health

Part 4: Hospital Activity Data

5.4 HOSPITAL ADMISSIONS

5.6.1 Source of Data

Data on inpatient admissions to hospitals in Cyprus were obtained from the Ministry of Finance. The data were in the form of individual records for each inpatient admission where the data of discharge was in the period 1998-2002. The records contained the following data items:

- Hospital;
- Department;
- Date of admission;
- Date of discharge;
- Sex;
- Age;
- Marital Status;
- Area of Permanent Residence (4 digit Community/Municipality code);
- Discharge Status;
- Diagnosis (ICD10 codes to 3 digits);
- Operation code (International Classification of Procedures in Medicine (ICPM) - Vol.1, Chapter 5: Surgical Procedure codes);
- Length of Stay (days).

Other than age and sex, the data did not contain any personal identifiers such as name, date of birth, identification number or address that might be used to identify individual patients.

5.6.2 Data Quality

1) Coverage

Without an independent source for comparison, it is not possible to ascertain to what extent the extracts obtained represent complete and comprehensive coverage of all inpatients discharged from hospital in Cyprus in the period 1998-2002. Table 5.16 shows a break down of the number of discharges by year for each of the hospitals in Cyprus. Interesting features are:

1. the low number of discharges during 1998 for both Nicosia General and Paphos District hospitals compared to the other years;
2. the low number of discharges for Paralimni hospital in 2000;
3. the low number of discharges for Polis Chrysochus hospital for 2001 and 2002.

These unusual figures may represent genuine fluctuations in hospital activity but may also be evidence of missing data records.

2) Completeness

The completeness of the key data items for this study, i.e. age, sex, area of residence and diagnosis, was extremely high. Table 5.17 shows the number and percentage of records with missing or invalid data for each of these variables. Sex and diagnosis fields were complete in 100% of records, and only a very small number of records did not contain a valid age. Area of residence was missing in 2% of records but this varied from 0.4% for Polis Chrysochous hospital to 3.1% and 6.8% at Limassol District and Paralimni hospitals respectively.

Table 5.18 shows a breakdown of the percentage of records with missing area of residence by the year of discharge. Although the level of completeness is very good it is of concern that the overall percentage of records with missing area data has increased over the five-year period.

5.6.3 Limitations of the Data

There are two major limitations of the hospital inpatient records data with respect to the investigation of disease clusters in Lakatamia:

1. The use of the hospital inpatient records as a proxy for disease incidence is severely hindered by the lack of personal identifiers in the data set. This means that it is not possible to link together those inpatients records that relate to the same individual patient. The number of times that a patient is admitted to hospital as a result of a particular instance of disease will vary depending on what the condition is, its severity, and also the hospital's treatment protocol for that condition. There may also be differences between hospitals in the way that multiple admissions for a particular course of treatment (e.g. chemotherapy) are recorded. As a result, the use of counts of hospital records may not accurately reflect the underlying incidence of disease, and geographical comparisons, in particular, may be artefactually biased.

2. The place of permanent residence recorded only by a 4-digit code, i.e. at the Community/Municipality level. It is not possible, therefore, to investigate hospitalisation rates for the individual Quarters of Lakatamia (i.e. Ayios Mammas, Ayia Paraskevi, Archangelos- Anthoupolis, and Ayios Nicolaos), as this requires the full 6-digit area code.

5.6.4 Analysis

For the analyses only those inpatient records with complete age, sex, diagnosis and 4-digit area of permanent residence data were used. There were 242,718 such records, representing 98.0% of the original 247,556 records in the data set.

A summary of the analysis of the inpatient records is given below with selected tables and figures. The full set of tables and figures including separate tables for males and females (where appropriate) can be found in Appendix 1.

Table 5.19 shows a breakdown of the proportion of inpatient records by type of cancer for Cyprus, Lefkosia District, and Lakatamia Municipality. Two sets of proportions are

given: as a percentage of all inpatient records; and as a percentage of all cancer inpatient records.

It shows that in Lakatamia Municipality and Lefkosia District the proportion of inpatients who were admitted due to cancer is slightly higher than the average for Cyprus (5.9%, 6.0% and 4.9% respectively). There are two other notable observations in the table, both for Lakatamia Municipality. The first is the low proportion of colorectal cancer inpatient records, although this may be the result of variability due to the low number of records involved (31 records). The second is the high proportion of urinary tract cancer records, approximately double that seen in Lefkosia District and Cyprus. It should be noted that this is a crude comparison that does not take into account the different age structures of the areas being compared. However it does indicate that there may be a particular issue with cancers of the urinary tract.

1) All Diseases

Table 5.20 shows the inpatient record rates for all diseases for Cyprus, Lefkosia District, selected Municipalities in and around Lefkosia city, and Lakatamia Municipality. It can be seen that all the comparator Municipalities including Lakatamia have a lower hospitalisation level than the average for Cyprus. The ratio for Lakatamia is approximately 10% lower than expected (ISR=90.8, 95%CI: 88.9-92.8). The funnel plot in Figure 5.16 shows that the Lakatamia ratio is below the lower control limit, i.e. it is statistically significantly lower than expected at the 99.8% confidence level. However, a much larger than expected number of Municipalities and Communities fall outside the control limits. This means that there are factors other than random variation which affect the distribution of Municipality/Community hospitalisation ratios, at least when considering hospitalisation for all diseases.

2) All Cancers

Table 5.21 shows the inpatient record rates for all cancers. With the exception of Geri, Lakatamia has the highest cancer hospitalisation rate of all the comparator Municipalities (ISR=128, 95%CI: 117.4-140.3). However, the rate is not dissimilar to that seen in Lefkosia and Latsia Municipalities (Figure 5.17). The funnel plot (Figure 5.18) shows that the Lakatamia ratio lies outside the control limits, but again it can be seen from the larger than expected number of observations outside of the control limits that there are additional risk factors affecting the distribution that have not been adjusted for.

When broken down by sex it can be seen that an excess of male hospitalisation is responsible for the high overall ratio in Lakatamia. The male ratio was statistically significantly higher than the Cyprus average (ISR= 153.7, 95%CI: 138.0-170.6). The female ratio was lower than expected but not statistically significantly different from the Cyprus average (ISR=91.5, 95%CI: 77.1-107.7). A similar observation was made for Geri. (See Appendix 1 for sex specific tables)

3) Stomach Cancer

Hospitalisation for stomach cancer was rare with only 8 records for Lakatamia and 296 for the whole of Cyprus Government controlled area during the period. It can be see from the funnel plot in Figure 5.19 that the Lakatamia stomach cancer inpatient record ratio was lower than expected and well within the expected variation.

4) Colorectal Cancer

Figure 5.20 shows the funnel plot for the colorectal cancer inpatient record ratios. The Lakatamia ratio of 77.8 (95%CI: 52.9-110.4) is lower than the Cyprus average but well within the control limits of the expected variation.

5) Lung Cancer

With an impatient record ratio of 129.8 (95%CI: 95.3-172.6) hospitalisation from Lung cancer in Lakatamia is higher than the Cyprus average but is not statistically significantly different. The ratio is well within the control limits of expected variation (Figure 5.21).

6) Breast Cancer

Table 5.22 shows the inpatient record rates for Lakatamia Municipality and its comparators for cancer of the female breast. The indirectly standardised ratio for Lakatamia Municipality is statistically significantly higher than expected (ISR=161.0, 95%CI: 118.7-213.4) but is still within the control limits of expected variation (Figure 5.22).

7) Cancer of the Uterus (any part)

The inpatient record ratio for Lakatamia for cancer of the uterus (any part) was not statistically significantly different from the Cyprus average (ISR= 118.8, 95%CI: 54.2-225.6) (Figure 5.23).

8) Cancer of the Prostate

Table 5.23 shows the inpatient record rates for Lakatamia Municipality and its comparators for prostate cancer. Hospitalisation for prostate cancer is higher than average within Lefkosia District as whole (ISR=166.9, 95%CI:150.4-184.7) and this is reflected in the ratios for all of the comparator Municipalities with the exception of Anthoupolis Refugee Housing Estate and Aglantzia. The Lakatamia ratio (ISR=280.1, 95%CI: 204.3-374.8) is the highest of the comparators and means that the number of hospitalisations observed was nearly 3 times higher than expected. The funnel plot in Figure 5.24 shows that this high ratio is outside of the control limits of the expected variation.

9) Cancer of the Urinary Tract

The observations for Lakatamia for hospitalisation from cancer of the urinary tract are similar to its observations for prostate cancer. Approximately 3 times as many records were observed than were expected (ISR=278.9, 95%CI: 228.8-336.8). Of the comparator Municipalities only Geri had a higher ratio (Table 5.24). The funnel plot in Figure 5.25 shows that the Lakatamia ratio exceeds the control limits of the expected variation. As

for all diseases and all cancers there is some suggestion that there is an excess of observations outside the limits and therefore that there may some other risk factors for the distribution, which have not been accounted for.

Breaking the records down by sex produces some unusual observations. For Cyprus there were 1239 inpatient records for cancer of the urinary tract of which 996 were male and 243 female. In Lakatamia the male/female split was 104/4. The result of this was an extremely high male ratio of 343.1 (95%CI: 280.3-415.1) a low female ratio of 47.6 (95%CI: 12.8-121.9).

10) Cancer of the Lymphoid, Haematopoietic and Related Tissue

With an inpatient record ratio of 123.6 (95%CI: 102.8-147.3) hospitalisation from lymphoid and related cancers in Lakatamia is higher than the Cyprus average with a difference that is just statistically significantly different at the 95% confidence level. However, the ratio is not outside the control limits of expected variation (Figure 5.26).

5.6.5 Conclusions

The analyses above highlighted prostate cancer and cancer of the urinary tract as having potentially extreme levels in Lakatamia.

1. The observation for prostate cancer hospitalisation is consistent with that seen for prostate cancer registration. It should be noted, however, that for the registrations it was the Quarters of Ayios Mammas and Ayios Nicolaos where the levels were high, not Ayia Paraskevi. Here it should be pointed out that prostate cancer is very age related in that it is largely a disease of older men. We would therefore expect high rates in Ayios Mammas.

2. The high level of hospitalisation for cancers of the urinary tract is NOT consistent with the unremarkable level of registrations for these cancers within Lakatamia. Of the two data sources the cancer registrations are considered to be a better proxy for the incidence of cancer than are the hospital inpatient records, for reasons discussed above in the Limitations of the data.

3. The most common urinary tract cancer is bladder cancer, a disease that requires frequent repeated follow-up cystoscopies. This means that a patient with bladder cancer is likely to require a number of hospital admissions. Variations in clinic practice, and variations in the frequency with which bladder cancers are followed up, are likely to have a significant impact on hospital admission rates, and this probably accounts for the high level found in Lakatamia.

4. Table 5.25 shows a comparison of the number of hospital inpatient records to the number of cancer registrations for each of the cancer type considered in the analyses for Cyprus, Lefkosia District and Lakatamia Municipality. It shows that there are 4.5 times as many inpatient records for urinary tract cancer as there are registrations. This suggests that the hospital records include multiple admissions for the same

individuals. The same ratio for Cyprus is much lower, 1.6. This provides evidence that the level of hospitalisation for urinary tract cancer in Lakatamia is artefactually inflated.

5. Overall therefore the hospital records do not provide any compelling evidence of the existence of an excess of level of cancer that might be attributable to a special source.

5.6.6 Recommendations

The recommendations below are made with a view to improving the inpatient records data set as a source of data for routine and ad-hoc epidemiological analyses such as this.

1. Personal identifiers, such as national Identification Number, name, sex, date of birth, address etc, should be included in the data set to allow linking of multiple records for individual patients. If there are confidentiality issues then a unique anonymised identifier could be used.

2. Efforts should be made to improve the high level of area of residence coding, which has deteriorated slightly over the period, and to routinely code the 6-digit Quarter where appropriate.

Tables and figures for hospital activity data are shown on pages 84 to 104 that follow this page.

Table 5.16
Hospital Inpatient Records By Hospital and Year of Discharge
Cyprus, Discharged 1998-2002

Hospital		Year of Discharge					Total 1998-2002
		1998	1999	2000	2001	2002	
H1	Nicosia General Hospital	6,336	9,682	10,806	11,890	10,652	49,366
H2	Archbishop Makarios III Hospital	10,509	9,497	9,285	9,025	8,410	46,726
H5	Larnaca District Hospital	6,914	5,573	6,752	7,352	8,325	34,916
H6	Limassol District Hospital	15,775	16,035	16,415	16,030	16,574	80,829
H7	Paphos District Hospital	3,402	4,943	6,038	6,327	6,498	27,208
R1	Kyperounta	664	664	449	740	620	3,137
R2	Paralimni	531	524	134	770	735	2,694
R3	Polis Chrysochous	334	366	252	162	155	1,269
S1	Athalassa Psychiatric Institution	269	258	284	306	294	1,411
	Cyprus (Government Controlled)	44,734	47,542	50,415	52,602	52,263	247,556

Source: Ministry of Finance

Table 5.17
Hospital Inpatient Records Missing Key Data Items By Hospital
Cyprus, Discharged 1998-2002

Hospital		All Inpatient Records	Inpatient Records With Missing:							
			Sex		Age		Area of Residence		Diagnosis	
			No	%	No	%	No	%	No	%
H1	Nicosia General Hospital	49,366	0	*0.0%*	6	*0.0%*	224	*0.5%*	0	*0.0%*
H2	Archbishop Makarios III Hospital	46,726	0	*0.0%*	1	*0.0%*	572	*1.2%*	0	*0.0%*
H5	Larnaca District Hospital	34,916	0	*0.0%*	1	*0.0%*	542	*1.6%*	0	*0.0%*
H6	Limassol District Hospital	80,829	0	*0.0%*	3	*0.0%*	2,535	*3.1%*	0	*0.0%*
H7	Paphos District Hospital	27,208	0	*0.0%*	0	*0.0%*	673	*2.5%*	0	*0.0%*
R1	Kyperounta	3,137	0	*0.0%*	0	*0.0%*	63	*2.0%*	0	*0.0%*
R2	Paralimni	2,694	0	*0.0%*	0	*0.0%*	184	*6.8%*	0	*0.0%*
R3	Polis Chrysochous	1,269	0	*0.0%*	0	*0.0%*	5	*0.4%*	0	*0.0%*
S1	Athalassa Psychiatric Institution	1,411	0	*0.0%*	5	*0.4%*	40	*2.8%*	0	*0.0%*
	Cyprus (Government Controlled)	247,556	0	*0.0%*	16	*0.0%*	4,838	*2.0%*	0	*0.0%*

Source: Ministry of Finance

Table 5.18
Percentage of Hospital Inpatient Records Missing Area of Residence
By Hospital and Year of Discharge
Cyprus, Discharged 1998-2002

Hospital		Year of Discharge					Total 1998-2002
		1998	1999	2000	2001	2002	
H1	Nicosia General Hospital	0.5%	0.3%	0.4%	0.6%	0.6%	0.5%
H2	Archbishop Makarios III Hospital	0.2%	1.7%	2.1%	1.5%	0.7%	1.2%
H5	Larnaca District Hospital	1.9%	1.5%	1.0%	1.6%	1.7%	0.6%
H6	Limassol District Hospital	2.6%	2.8%	3.1%	3.5%	3.7%	3.1%
H7	Paphos District Hospital	0.3%	2.6%	2.6%	2.5%	3.5%	2.5%
R1	Kyperounta	3.0%	2.7%	1.1%	1.5%	1.5%	0.1%
R2	Paralimni	4.7%	7.1%	3.7%	9.1%	6.4%	6.8%
R3	Polis Chrysochous	1.2%	0.0%	0.0%	0.6%	0.0%	0.4%
S1	Athalassa Psychiatric Institution	1.1%	2.7%	2.1%	4.2%	3.7%	1.0%
	Cyprus (Government Controlled)	1.5%	1.9%	1.9%	2.2%	2.2%	2.0%

Source: Ministry of Finance

Table 5.19
Hospital Inpatient Records for Selected Diseases
Cyprus (Government Controlled), Lefkosia District and Lakatamia Municipality, Discharged 1998-2002

Disease	Cyprus			Lefkosia District			Lakatamia Municipality		
	Records	*% of All Diseases*	*% of All Cancers*	Records	*% of All Diseases*	*% of All Cancers*	Records	*% of All Diseases*	*% of All Cancers*
Stomach Cancer (ICD10 C16)	296	*0.1%*	*2.5%*	132	*0.2%*	*2.8%*	8	*0.1%*	*1.6%*
Colorectal Cancer (ICD10 C18-C20)	1,289	*0.5%*	*10.9%*	546	*0.7%*	*11.4%*	31	*0.4%*	*6.3%*
Lung Cancer (ICD10 C34)	1,179	*0.5%*	*10.0%*	511	*0.6%*	*10.7%*	47	*0.6%*	*9.5%*
Breast Cancer (ICD10 C50)	892	*0.4%*	*7.5%*	427	*0.5%*	*8.9%*	48	*0.6%*	*9.7%*
Uterus (Any Part) (ICD10 C53-C55)	239	*0.1%*	*2.0%*	121	*0.2%*	*2.5%*	9	*0.1%*	*1.8%*
Cancer of the Prostate (ICD10 C61)	565	*0.2%*	*4.8%*	373	*0.5%*	*7.8%*	45	*0.5%*	*9.1%*
Cancers of the Urinary Tract (ICD10 C64-C68)	1,239	*0.5%*	*10.5%*	671	*0.8%*	*14.0%*	108	*1.3%*	*21.8%*
Cancers of the Lymphoid, Haematopoietic and Related Tissue (ICD10 C81-C96)	2,772	*1.1%*	*23.5%*	1,017	*1.3%*	*21.2%*	124	*1.5%*	*25.1%*
Other Cancers	3,348	*1.4%*	*28.3%*	998	*1.2%*	*20.8%*	75	*0.9%*	*15.2%*
All Cancers (ICD10 C00-C97)	11,819	*4.9%*	*100.0%*	4,796	*6.0%*	*100.0%*	495	*5.9%*	*100.0%*
All Diseases	242,71	*100.0%*		79,953	*100.0%*		8,431	*100.0%*	

Source: Ministry of Finance

Table 5.20
Hospital Inpatient Records for All Diseases
Crude Rate, Directly Standardised Rates and Indirectly Standardised Ratios
By District and Selected Municipalities
Cyprus, Persons, Discharged 1998-2002

Area		Count	Crude Rate[1]	DSR[1, 2]		Standardised Ratio[4]	
				Rate	*95% CI[3]*	Ratio	*95% CI[3]*
0	Cyprus (Government Controlled)	242,718	7,039.7	7,121.5	*7,061.1 - 7,182.5*	100.0	*99.6 - 100.4*
1	LEFKOSIA DISTRICT	79,953	5,843.6	5,946.7	*5,858.0 - 6,036.7*	83.2	*82.6 - 83.8*
3	AMMOCHOSTOS DISTRICT	8,074	4,279.0	4,612.1	*4,399.7 - 4,834.7*	63.1	*61.7 - 64.5*
4	LARNAKA DISTRICT	36,678	6,364.0	6,491.1	*6,349.5 - 6,636.0*	90.7	*89.8 - 91.6*
5	LEMESOS DISTRICT	86,968	8,940.2	9,258.9	*9,132.4 - 9,387.2*	130.8	*129.9 - 131.7*
6	PAFOS DISTRICT	31,045	9,356.0	9,130.0	*8,916.5 - 9,348.6*	128.9	*127.5 - 130.3*
1000	Lefkosia Municipality	17,232	7,205.2	6,953.2	*6,727.3 - 7,186.8*	98.1	*96.6 - 99.6*
1010	Ayios Dometios Municipality	3,889	6,414.8	6,275.2	*5,848.8 - 6,732.6*	86.0	*83.3 - 88.8*
1011	Egkomi Municipality	2,476	3,629.4	4,047.7	*3,716.4 - 4,408.6*	54.7	*52.6 - 56.9*
1012	Strovolos Municipality	13,699	4,681.4	4,917.1	*4,741.7 - 5,099.1*	68.3	*67.2 - 69.5*
1013	Aglantzia Municipality-Aglangia	4,637	4,893.2	5,097.5	*4,786.3 - 5,428.9*	71.0	*69.0 - 73.1*
1021	**Lakatamia Municipality**	**8,431**	**5,921.3**	**6,633.0**	***6,329.2 - 6,951.3***	**90.8**	***88.9 - 92.8***
1022	Anthoupolis Refugee Housing Est.	447	3,587.5	4,529.2	*3,615.4 - 5,674.1*	41.7	*37.9 - 45.7*
1023	Latsia Municipality (Lakkia)	3,502	5,743.3	6,123.8	*5,701.8 - 6,577.1*	85.6	*82.7 - 88.4*
1024	Geri	1,801	5,590.6	6,441.7	*5,806.1 - 7,147.0*	89.4	*85.3 - 93.6*

Source: Ministry of Finance

1 - Crude rates and DSRs are expressed per 100,000 population per year
2 - DSRs use the European Standard Population.
3 - 95% confidence interval
4 - Indirectly Standardised Ratios use Cyprus (Government Controlled) rates as the standard.

Table 5.21
Hospital Inpatient Records for All Cancers (ICD10 C00-C97)
Crude Rate, Directly Standardised Rates and Indirectly Standardised Ratios
By District and Selected Municipalities
Cyprus, Persons, Discharged 1998-2002

Area		Count	Crude Rate[1]	DSR[1, 2]		Standardised Ratio[4]	
				Rate	*95% CI[3]*	Ratio	*95% CI[3]*
0	Cyprus (Government Controlled)	11,819	342.8	345.6	*331.9 - 359.9*	100.0	*98.2 - 101.8*
1	LEFKOSIA DISTRICT	4,796	350.5	348.0	*326.6 - 370.9*	102.1	*99.2 - 105.0*
3	AMMOCHOSTOS DISTRICT	435	230.5	263.0	*212.9 - 324.9*	76.7	*69.6 - 84.2*
4	LARNAKA DISTRICT	1,605	278.5	293.8	*263.1 - 328.0*	83.4	*79.3 - 87.5*
5	LEMESOS DISTRICT	3,872	398.0	411.6	*383.7 - 441.5*	122.6	*118.7 - 126.5*
6	PAFOS DISTRICT	1,111	334.8	322.6	*282.6 - 368.3*	92.0	*86.7 - 97.6*
1000	Lefkosia Municipality	1,116	466.6	405.2	*354.4 - 463.2*	121.6	*114.6 - 128.9*
1010	Ayios Dometios Municipality	188	310.1	257.8	*186.0 - 357.3*	75.3	*64.9 - 86.9*
1011	Egkomi Municipality	158	231.6	262.6	*184.7 - 373.5*	78.0	*66.3 - 91.1*
1012	Strovolos Municipality	855	292.2	302.9	*260.8 - 351.8*	87.6	*81.9 - 93.7*
1013	Aglantzia Municipality-Aglangia	241	254.3	258.9	*195.2 - 343.5*	73.7	*64.7 - 83.6*
1021	**Lakatamia Municipality**	**495**	**347.6**	**430.1**	***350.8 - 527.4***	**128.4**	***117.4 - 140.3***
1022	Anthoupolis Refugee Housing Est.	9	72.2	63.4	*11.7 - 343.3*	12.8	*5.8 - 24.3*
1023	Latsia Municipality (Lakkia)	215	352.6	383.6	*283.9 - 518.2*	114.4	*99.6 - 130.8*
1024	Geri	129	400.4	553.7	*371.6 - 825.2*	164.3	*137.2 - 195.2*

Source: Ministry of Finance

1 - Crude rates and DSRs are expressed per 100,000 population per year
2 - DSRs use the European Standard Population.
3 - 95% confidence interval
4 - Indirectly Standardised Ratios use Cyprus (Government Controlled) rates as the standard.

Table 5.22
Hospital Inpatient Records for Breast Cancer (ICD10 C50)
Crude Rate, Directly Standardised Rates and Indirectly Standardised Ratios
By District and Selected Municipalities
Cyprus, Females, Discharged 1998-2002

Area		Count	Crude Rate[1]	DSR[1, 2]		Standardised Ratio[4]	
				Rate	*95% CI[3]*	Ratio	*95% CI[3]*
0	Cyprus (Government Controlled)	892	50.8	51.2	*44.1 - 59.4*	100.0	*93.5 - 106.8*
1	LEFKOSIA DISTRICT	427	61.0	59.8	*48.2 - 74.1*	118.6	*107.7 - 130.4*
3	AMMOCHOSTOS DISTRICT	48	51.4	60.6	*32.0 - 114.6*	116.1	*85.6 - 154.0*
4	LARNAKA DISTRICT	146	50.0	52.5	*36.4 - 75.8*	102.3	*86.4 - 120.4*
5	LEMESOS DISTRICT	185	36.7	36.9	*26.7 - 51.1*	71.2	*61.3 - 82.2*
6	PAFOS DISTRICT	86	51.8	50.8	*31.5 - 82.0*	97.5	*78.0 - 120.4*
1000	Lefkosia Municipality	145	116.7	99.1	*68.3 - 143.7*	200.7	*169.4 - 236.1*
1010	Ayios Dometios Municipality	15	47.6	37.4	*11.8 - 118.3*	78.3	*43.8 - 129.2*
1011	Egkomi Municipality	18	51.0	64.4	*22.6 - 183.1*	116.4	*68.9 - 184.0*
1012	Strovolos Municipality	86	57.0	56.0	*34.8 - 90.0*	112.5	*90.0 - 139.0*
1013	Aglantzia Municipality-Aglangia	11	22.5	21.8	*5.7 - 82.6*	42.0	*21.0 - 75.2*
1021	**Lakatamia Municipality**	**48**	**66.0**	**86.4**	***44.9 - 166.3***	**165.3**	***121.9 - 219.2***
1022	Anthoupolis Refugee Housing Est.	0	0.0	0.0	-	0.0	*0.0 - 64.4*
1023	Latsia Municipality (Lakkia)	18	57.7	61.8	*21.8 - 175.1*	122.0	*72.3 - 192.9*
1024	Geri	5	30.9	40.8	*4.9 - 340.1*	83.2	*26.8 - 194.1*

Source: Ministry of Finance

1 - Crude rates and DSRs are expressed per 100,000 population per year
2 - DSRs use the European Standard Population.
3 - 95% confidence interval
4 - Indirectly Standardised Ratios use Cyprus (Government Controlled) rates as the standard.

Table 5.23
Hospital Inpatient Records for Cancer of the Prostate (ICD10 C61)
Crude Rate, Directly Standardised Rates and Indirectly Standardised Ratios
By District and Selected Municipalities
Cyprus, Males, Discharged 1998-2002

Area		Count	Crude Rate[1]	DSR[1, 2]		Standardised Ratio[4]	
				Rate	*95% CI*[3]	Ratio	*95% CI*[3]
0	Cyprus (Government Controlled)	565	33.4	33.9	*28.2 - 40.8*	100.0	*91.9 - 108.6*
1	LEFKOSIA DISTRICT	373	55.8	56.1	*44.7 - 70.4*	166.9	*150.4 - 184.7*
3	AMMOCHOSTOS DISTRICT	30	31.5	40.7	*18.3 - 90.5*	119.4	*80.6 - 170.5*
4	LARNAKA DISTRICT	47	16.5	17.7	*9.3 - 33.7*	51.1	*37.5 - 67.9*
5	LEMESOS DISTRICT	79	16.9	21.8	*13.1 - 36.1*	64.3	*50.9 - 80.1*
6	PAFOS DISTRICT	36	21.7	20.0	*9.6 - 41.8*	59.2	*41.4 - 81.9*
1000	Lefkosia Municipality	96	83.6	67.2	*42.7 - 105.7*	205.1	*166.1 - 250.5*
1010	Ayios Dometios Municipality	19	65.2	49.7	*18.0 - 137.1*	145.4	*87.5 - 227.1*
1011	Egkomi Municipality	15	45.6	57.7	*18.7 - 178.1*	170.3	*95.2 - 280.9*
1012	Strovolos Municipality	67	47.3	52.0	*30.5 - 88.7*	152.7	*118.3 - 193.9*
1013	Aglantzia Municipality-Aglangia	15	32.7	37.2	*12.0 - 115.8*	106.7	*59.7 - 176.0*
1021	**Lakatamia Municipality**	**45**	**64.6**	**91.6**	***46.8 - 179.2***	**280.1**	***204.3 - 374.8***
1022	Anthoupolis Refugee Housing Est.	0	0.0	0.0	-	0.0	*0.0 - 94.0*
1023	Latsia Municipality (Lakkia)	10	33.6	43.8	*10.9 - 175.6*	124.2	*59.5 - 228.5*
1024	Geri	6	37.5	64.4	*10.5 - 393.6*	201.5	*73.6 - 438.6*

Source: Ministry of Finance

1 - Crude rates and DSRs are expressed per 100,000 population per year
2 - DSRs use the European Standard Population.
3 - 95% confidence interval
4 - Indirectly Standardised Ratios use Cyprus (Government Controlled) rates as the standard.

Table 5.24
Hospital Inpatient Records for Cancers of the Urinary Tract (ICD10 C64-C68)
Crude Rate, Directly Standardised Rates and Indirectly Standardised Ratios
By District and Selected Municipalities
Cyprus, Persons, Discharged 1998-2002

Area		Count	Crude Rate[1]	DSR[1, 2]		Standardised Ratio[4]	
				Rate	*95% CI[3]*	Ratio	*95% CI[3]*
0	Cyprus (Government Controlled)	1,239	35.9	35.1	*31.0 - 39.8*	100.0	*94.5 - 105.7*
1	LEFKOSIA DISTRICT	671	49.0	46.6	*39.2 - 55.3*	136.6	*126.4 - 147.3*
3	AMMOCHOSTOS DISTRICT	55	29.1	34.0	*18.8 - 61.5*	95.1	*71.7 - 123.8*
4	LARNAKA DISTRICT	239	41.5	43.1	*32.4 - 57.5*	118.3	*103.8 - 134.3*
5	LEMESOS DISTRICT	151	15.5	15.9	*11.1 - 22.7*	49.6	*42.0 - 58.1*
6	PAFOS DISTRICT	123	37.1	35.6	*23.9 - 53.0*	94.9	*78.9 - 113.3*
1000	Lefkosia Municipality	159	66.5	52.6	*36.8 - 75.2*	161.4	*137.3 - 188.5*
1010	Ayios Dometios Municipality	21	34.6	25.5	*9.7 - 67.2*	77.8	*48.1 - 118.9*
1011	Egkomi Municipality	16	23.5	29.5	*9.8 - 88.6*	78.3	*44.7 - 127.1*
1012	Strovolos Municipality	136	46.5	48.1	*33.0 - 70.1*	136.8	*114.7 - 161.8*
1013	Aglantzia Municipality-Aglangia	31	32.7	32.6	*14.8 - 71.9*	94.6	*64.3 - 134.3*
1021	**Lakatamia Municipality**	**108**	**75.9**	**95.1**	***61.7 - 146.6***	**278.9**	***228.8 - 336.8***
1022	Anthoupolis Refugee Housing Est.	0	0.0	0.0	-	0.0	*0.0 - 47.4*
1023	Latsia Municipality (Lakkia)	29	47.6	57.9	*25.7 - 130.7*	153.5	*102.8 - 220.5*
1024	Geri	47	145.9	194.6	*102.6 - 368.9*	618.9	*454.7 - 823.0*

Source: Ministry of Finance

1 - Crude rates and DSRs are expressed per 100,000 population per year
2 - DSRs use the European Standard Population.
3 - 95% confidence interval
4 - Indirectly Standardised Ratios use Cyprus (Government Controlled) rates as the standard.

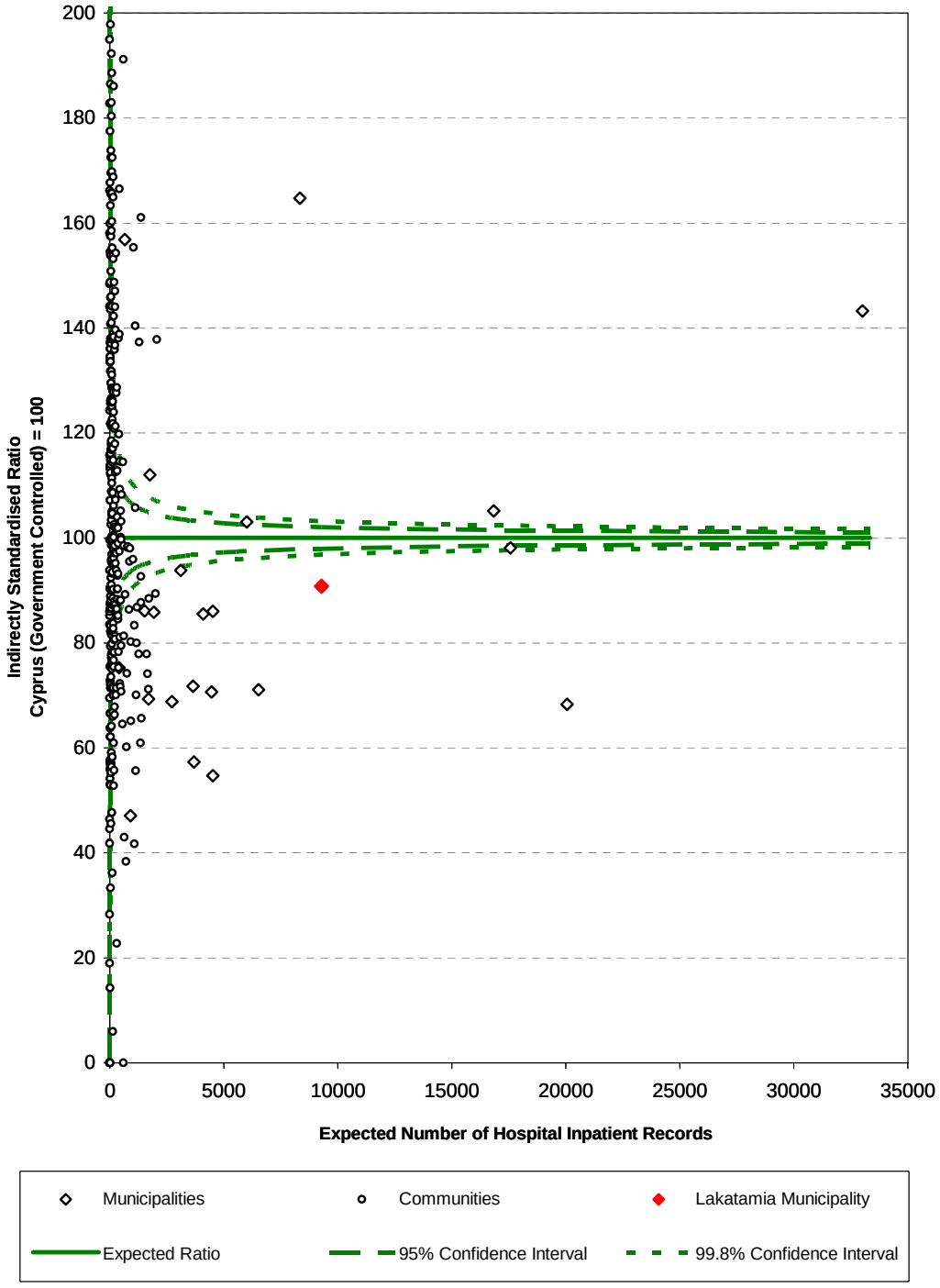
Table 5.25
Comparison of Inpatient Records and Cancer Registrations By Type Of Cancer
Cyprus (Government Controlled), Lefkosia District, and Lakatamia Municipality
Inpatients Discharged and Cancers Registered 1998-2002

Cancer	Cyprus (Government Controlled)			Lefkosia District			Lakatamia Municipality		
	Inpatient Records	Cancer Reg's	Ratio	Inpatient Records	Cancer Reg's	Ratio	Inpatient Records	Cancer Reg's	Ratio
Stomach Cancer (ICD10 C16)	296	300	1.0 : 1	132	111	1.2 : 1	8	9	0.9 : 1
Colorectal Cancer (ICD10 C18-C20)	1,289	947	1.4 : 1	546	396	1.4 : 1	31	27	1.1 : 1
Lung Cancer (ICD10 C33-C34)	1,185	691	1.7 : 1	513	308	1.7 : 1	47	27	1.7 : 1
Breast Cancer (ICD10 C50)	914	1,473	0.6 : 1	438	646	0.7 : 1	48	59	0.8 : 1
Uterus (Any Part) (ICD10 C53-C55)	239	398	0.6 : 1	121	173	0.7 : 1	9	18	0.5 : 1
Cancer of the Prostate (ICD10 C61)	565	1,008	0.6 : 1	373	483	0.8 : 1	45	47	1.0 : 1
Cancers of the Urinary Tract (ICD10 C64-C68)	1,239	761	1.6 : 1	671	284	2.4 : 1	108	24	4.5 : 1
Cancers of the Lymphoid, Haematopoietic and Related Tissue (ICD10 C81-C96)	2,772	712	3.9 : 1	1,017	295	3.4 : 1	124	25	5.0 : 1
Other Cancers	3,320	1,961	1.7 : 1	985	840	1.2 : 1	75	65	1.2 : 1
Total All Cancers	11,819	8,251	1.4 : 1	4,796	3,536	1.4 : 1	495	301	1.6 : 1

Source: Ministry of Finance, Ministry of Health

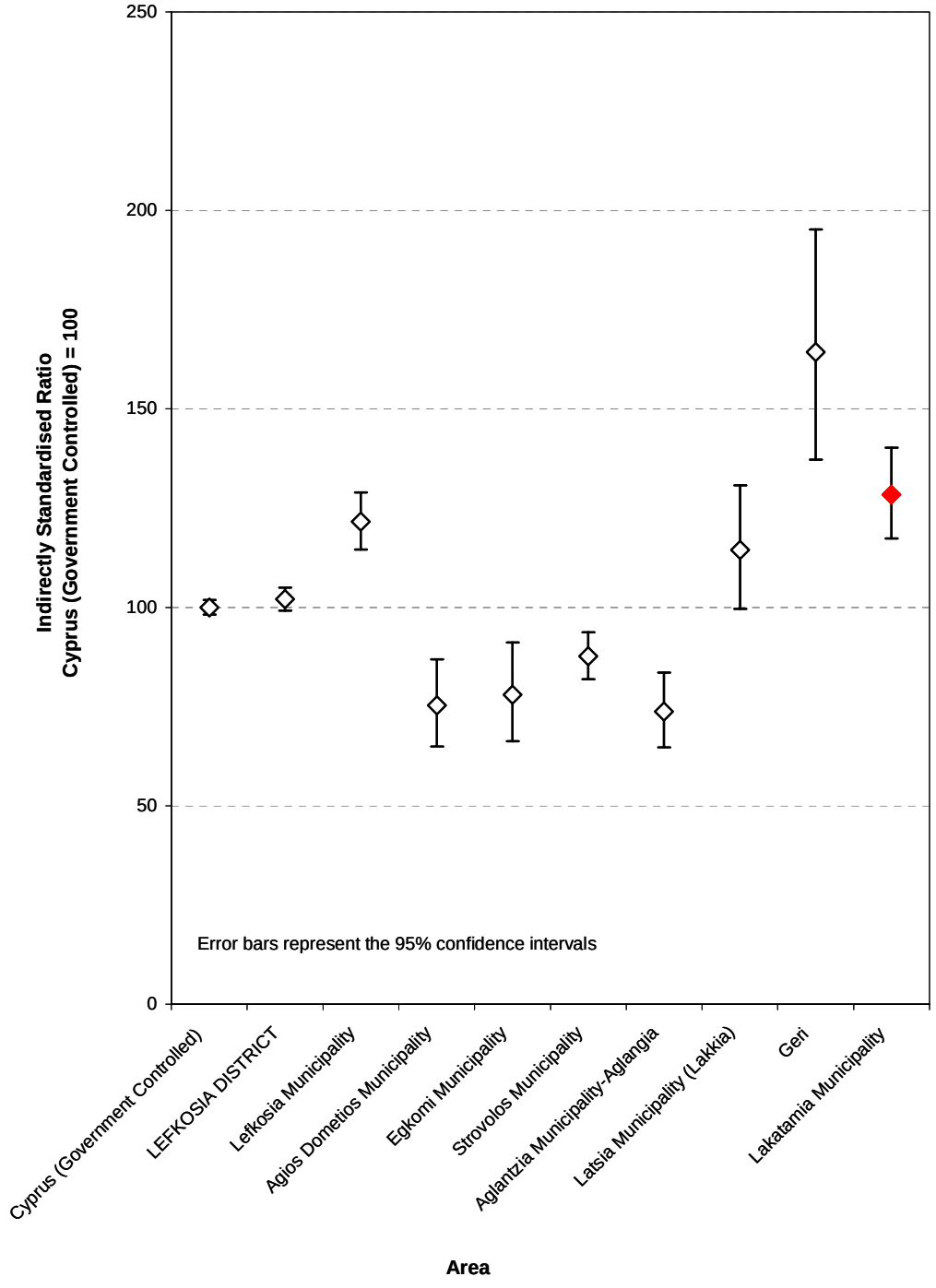
Figure 5.16

Hospital Inpatient Records for All Diseases
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Persons, Discharged 1998-2002



Source: Ministry of Finance

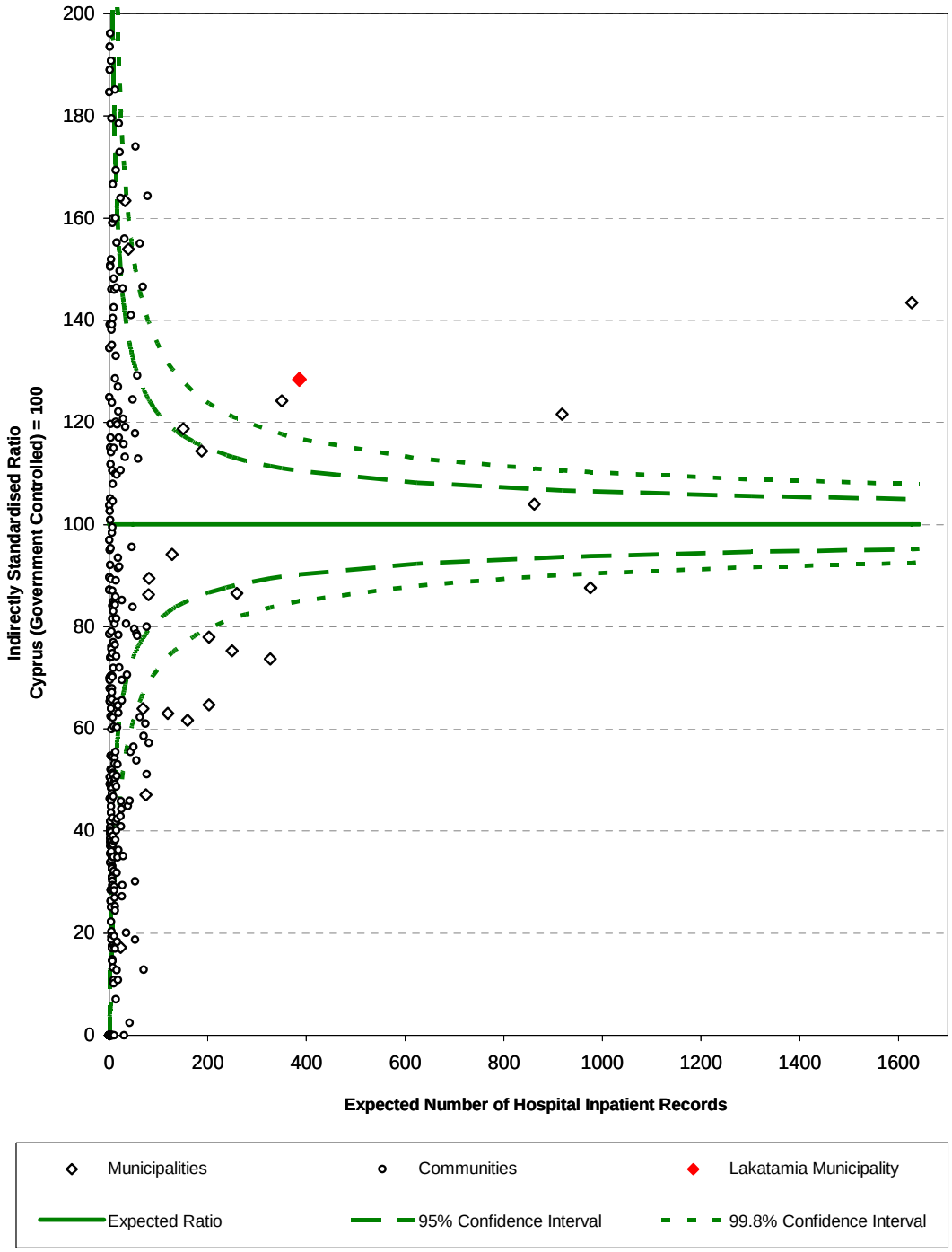
Figure 5.17
Hospital Inpatient Records for All Cancers (ICD10 C00-C97)
Indirectly Standardised Ratios by Selected District/Municipality/Community
Cyprus, Persons, Discharged 1998-2002



Source: Ministry of Finance

Figure 5.18

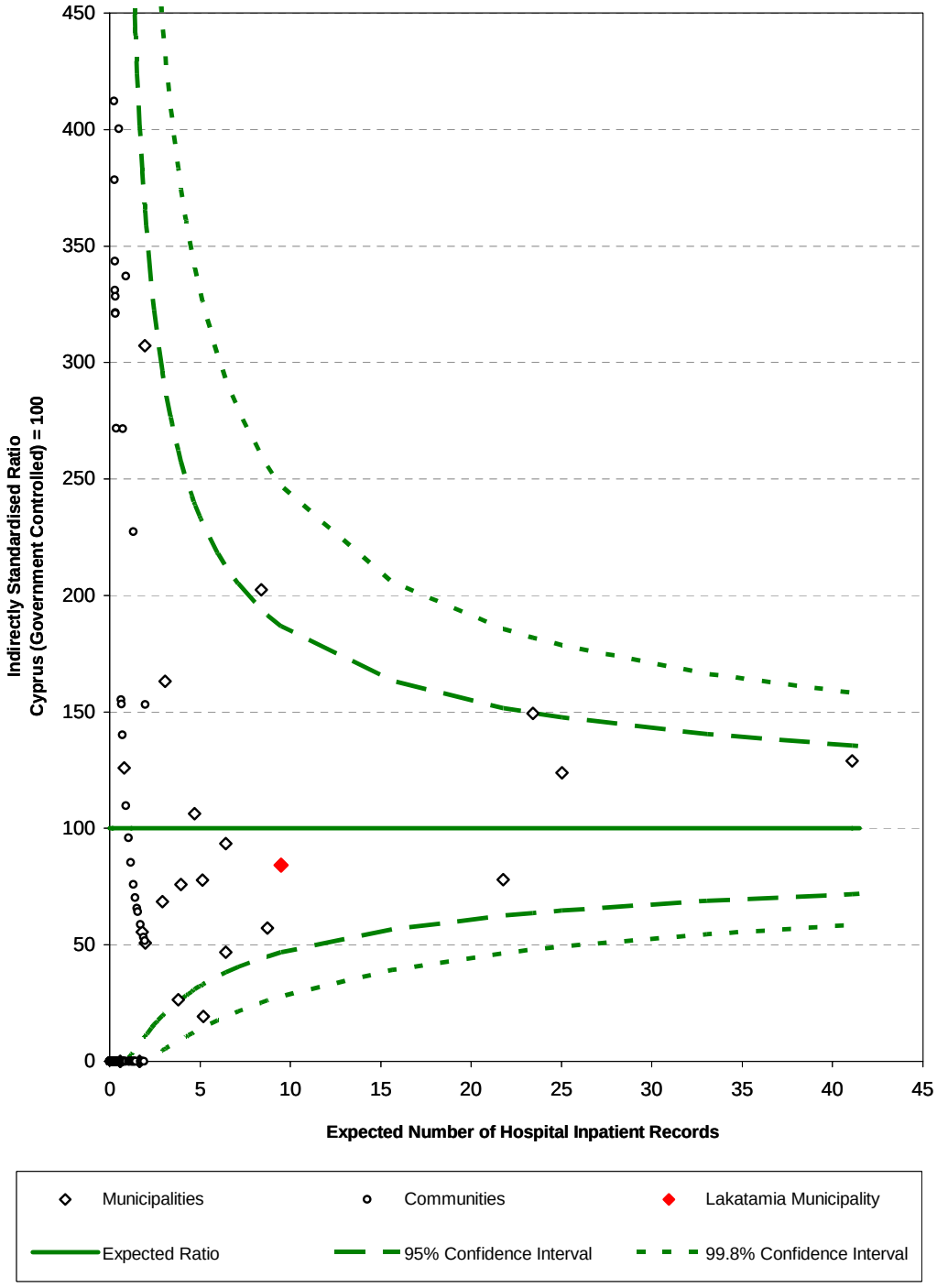
Hospital Inpatient Records for All Cancers (ICD10 C00-C97)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Persons, Discharged 1998-2002



Source: Ministry of Finance

Figure 5.19

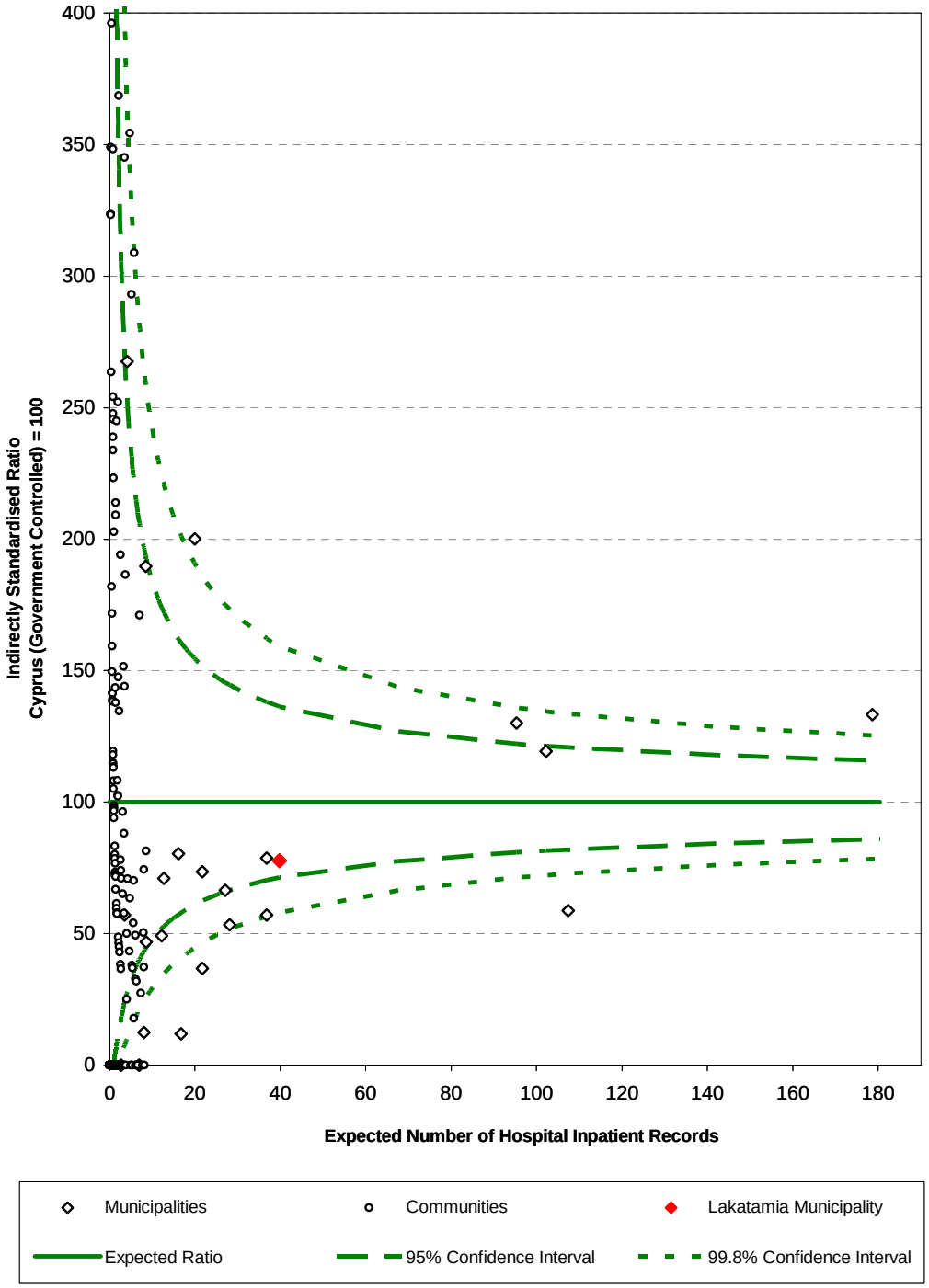
Hospital Inpatient Records for Stomach Cancer (ICD10 C16)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Persons, Discharged 1998-2002



Source: Ministry of Finance

Figure 5.20

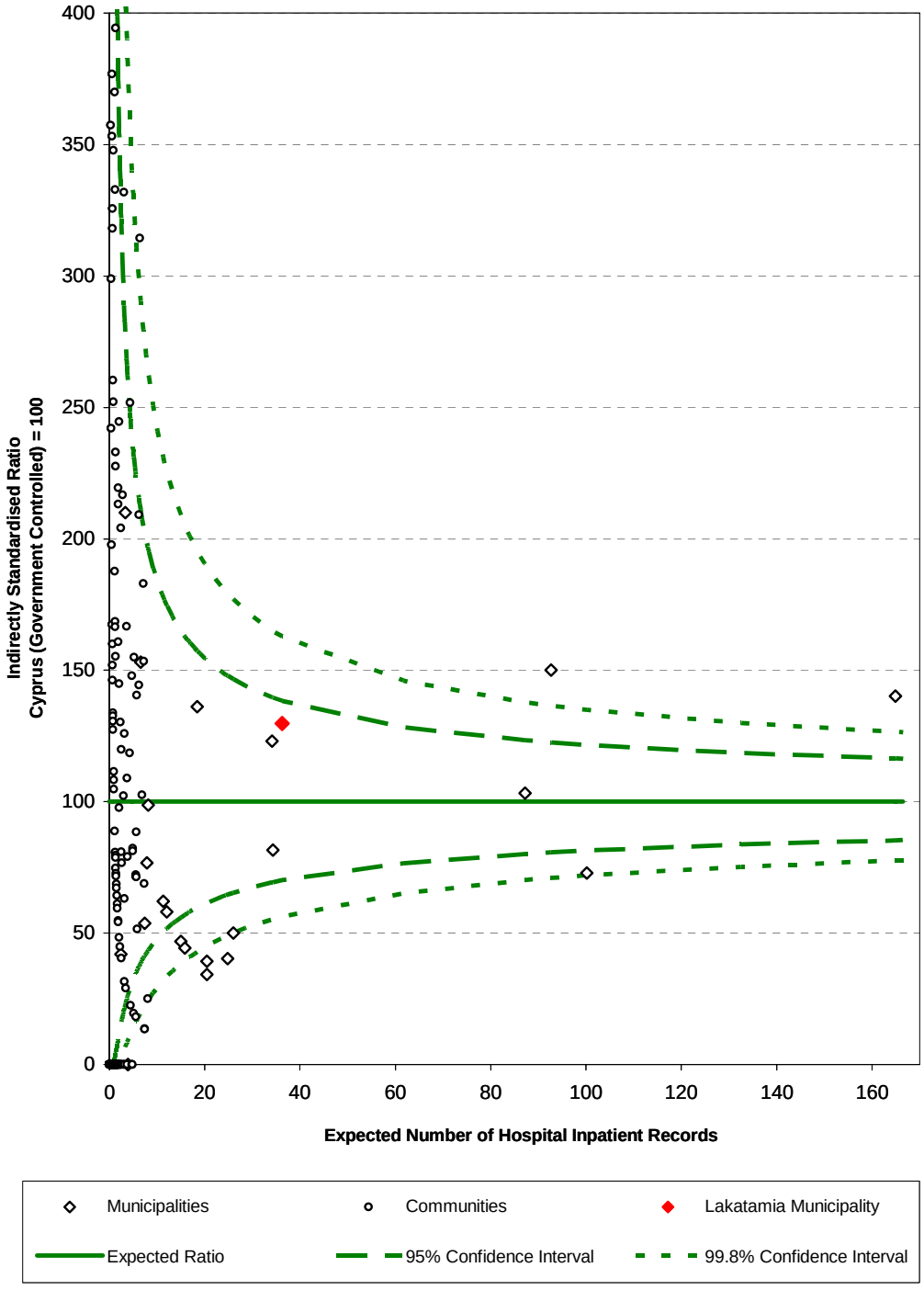
Hospital Inpatient Records for Colorectal Cancer (ICD10 C18-C20)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Persons, Discharged 1998-2002



Source: Ministry of Finance

Figure 5.21

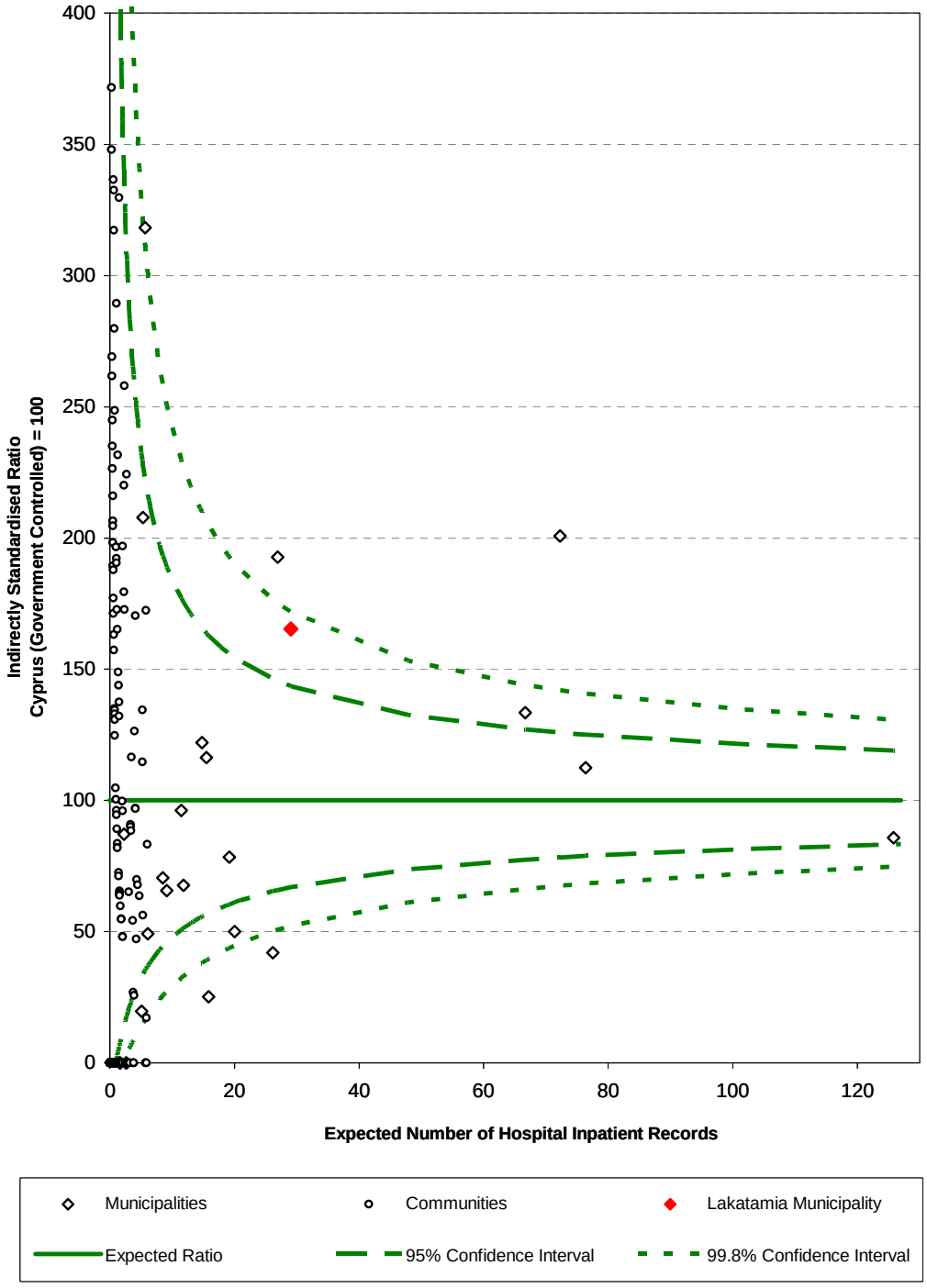
Hospital Inpatient Records for Lung Cancer (ICD10 C33-C34)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Persons, Discharged 1998-2002



Source: Ministry of Finance

Figure 5.22

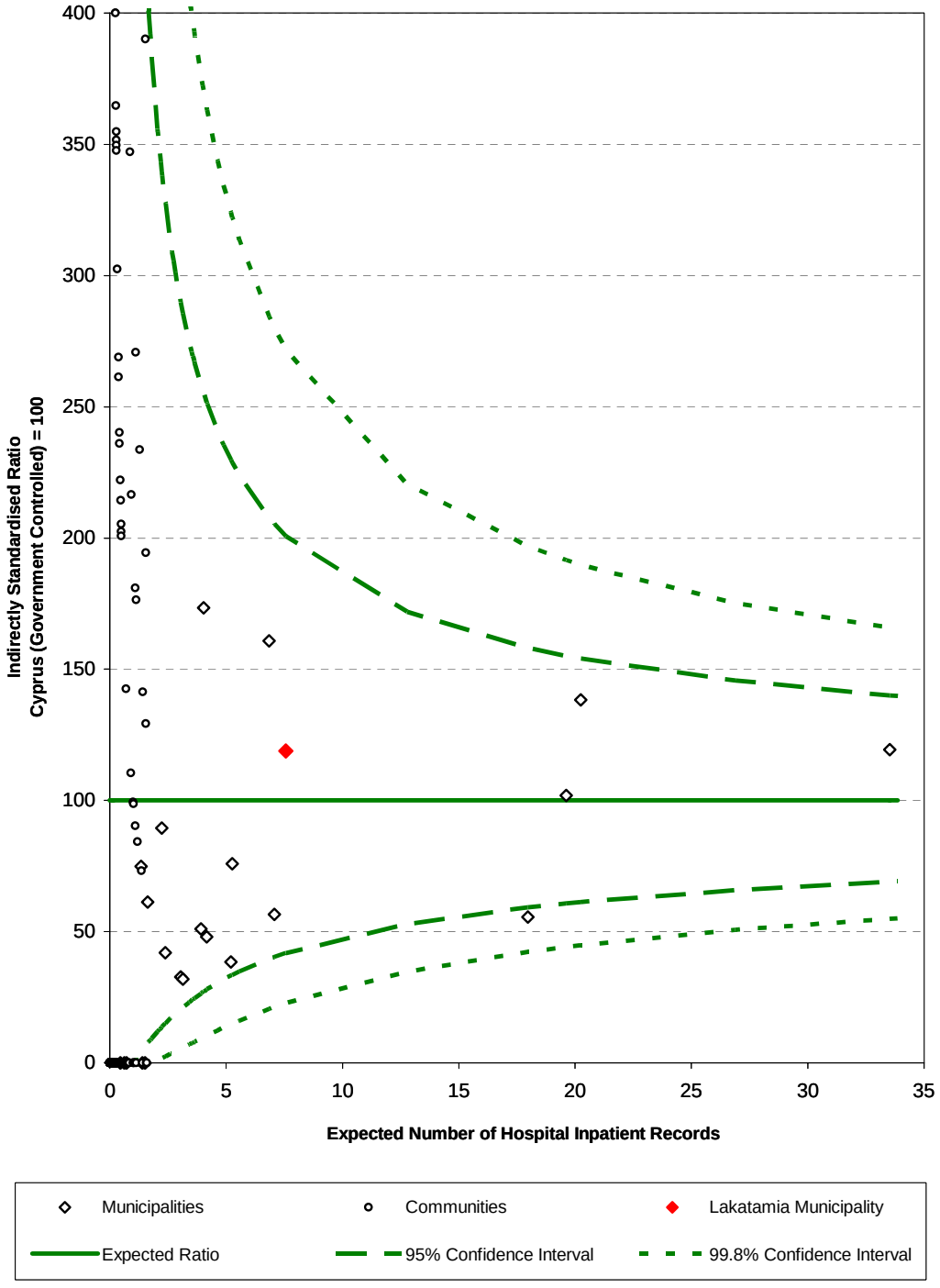
Hospital Inpatient Records for Breast Cancer (ICD10 C50)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Females, Discharged 1998-2002



Source: Ministry of Finance

Figure 5.23

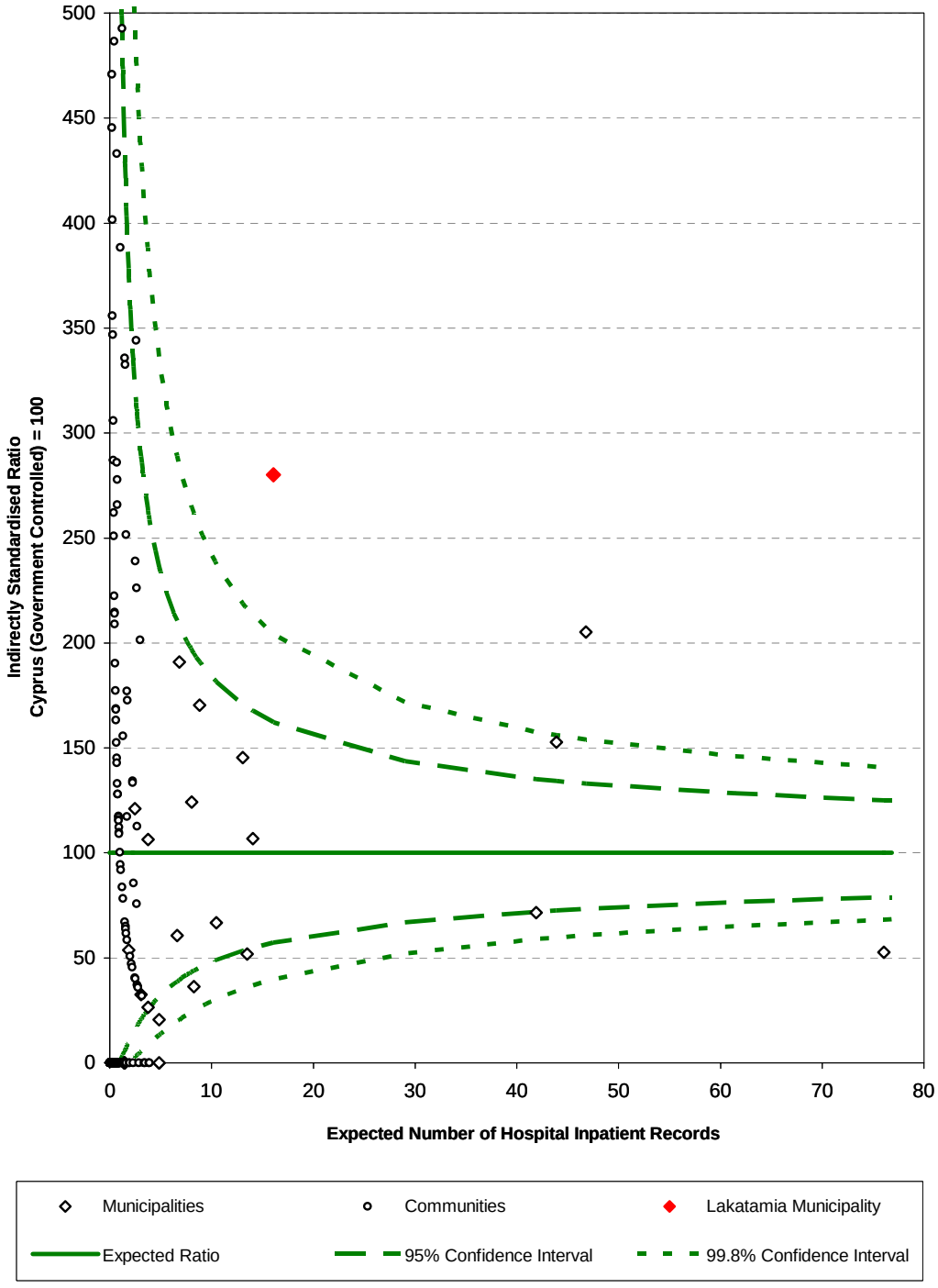
Hospital Inpatient Records for Cancer of the Uterus (any part) (ICD10 C53-C59)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Females, Discharged 1998-2002



Source: Ministry of Finance

Figure 5.24

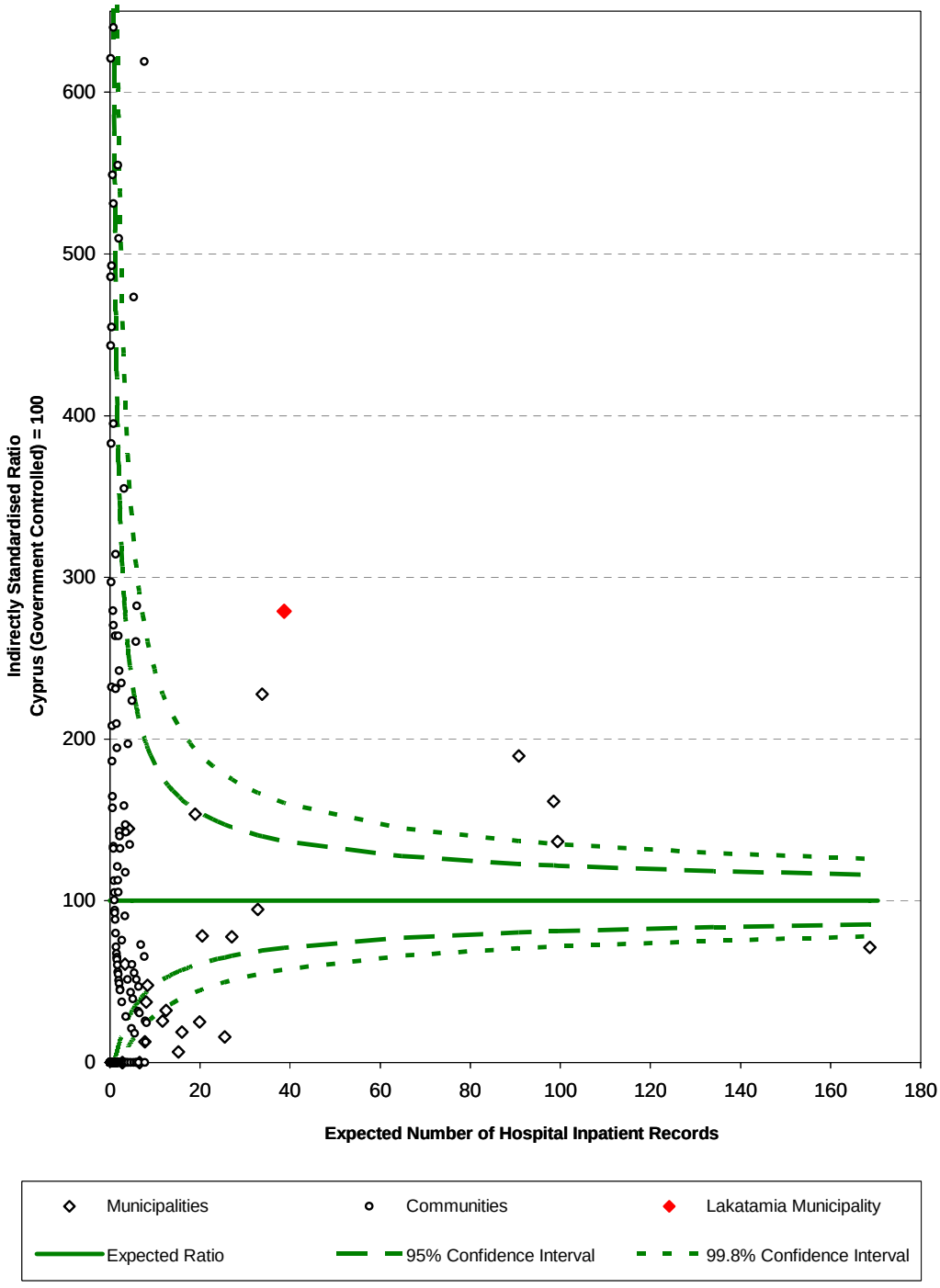
Hospital Inpatient Records for Cancer of the Prostate (ICD10 C61)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Males, Discharged 1998-2002



Source: Ministry of Finance

Figure 5.25

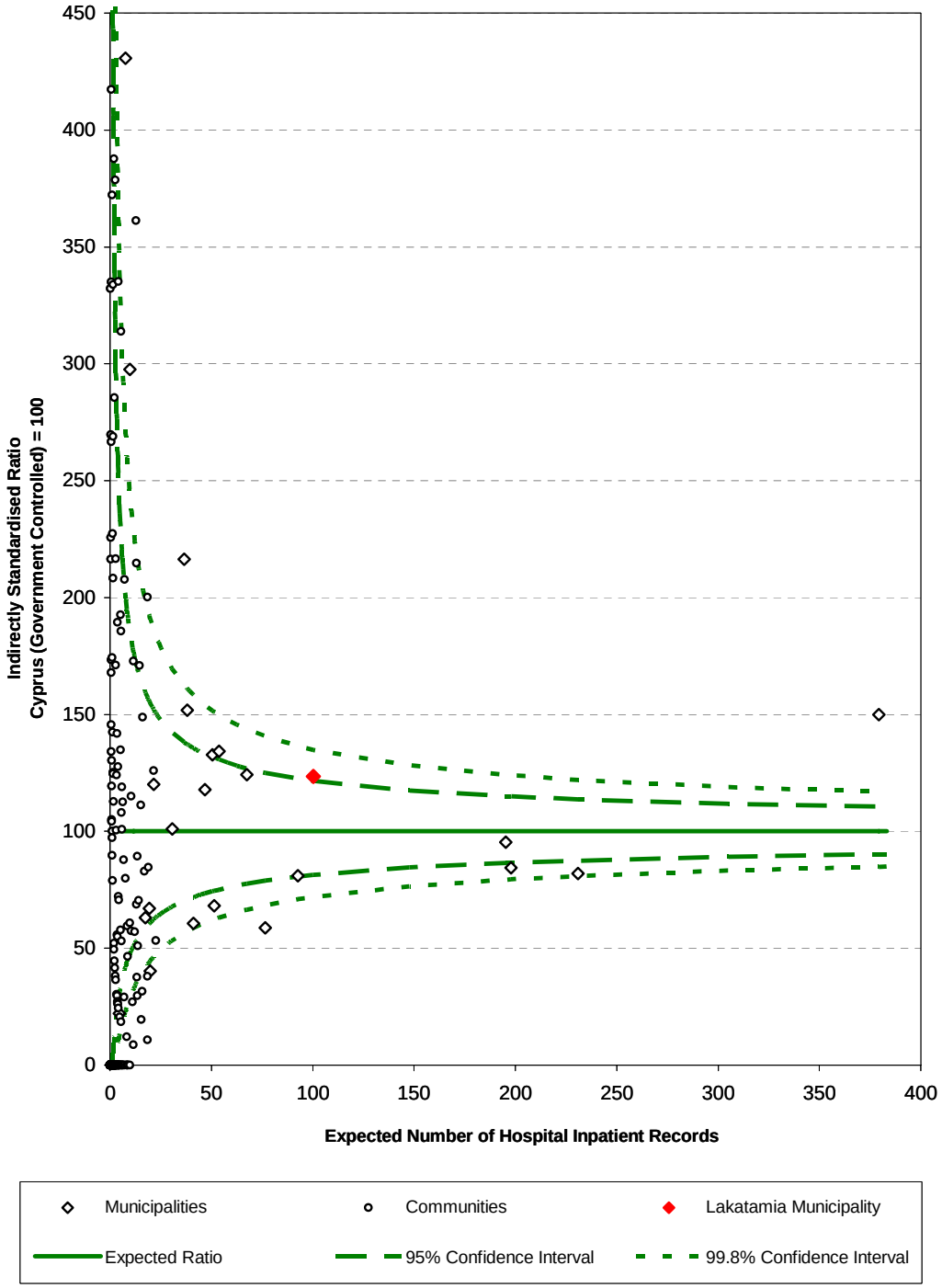
Hospital Inpatient Records for Cancers of the Urinary Tract (ICD10 C64-C68)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Persons, Discharged 1998-2002



Source: Ministry of Finance

Figure 5.26

Hospital Inpatient Records for Cancers of the Lymphoid, Haematopoietic and Related Tissue (ICD10 C81-C96)
Funnel Plot of Indirectly Standardised Ratios by Municipality/Community
Cyprus, Persons, Discharged 1998-2002



Source: Ministry of Finance

Section 6

Assessment of social and medical perceived risk

1. INTRODUCTION

In our literature review we saw that many perceived cancer cluster are just that; a perception in the mind of the local population that there are environmental risk factors that are causing an excess of cancers in the local population. However, the research shows that the perception of a cancer cluster is important to the local population, and a successful outcome to a cluster investigation can only be achieved if the concerns and worries of local people are taken seriously by the health authorities. Moreover, it is not sufficient simply to demonstrate statistically that there is not an excess of cancers, it is necessary to convince the local population that their concerns are taken seriously. This means that the authorities need to engage with the local population and help them to see the perceived cluster in perspective.

Recent developments in thinking about risk have resulted in an understanding that risk is a multifaceted concept with a number of different qualitative dimensions. These additional dimensions include psychological and socially influenced aspects, and political, economic and ethical characteristics. In 1992 the British Royal Society discussed advances in the social scientific theories of risk, and since then it has become increasing accepted that the assessment of an environmental hazard needs to take account of the public's view. That is, the public's view of the perceived risk to health and well being of the community has become a factor in the assessment of risk. This is because the perception of risk affects how people react to environmental hazards and the need for the public's viewpoint to be considered has been increasingly recognised.[1] For example, a study examined the reactions of Finnish people to an incident at a Russian nuclear power plant. A sample of subjects from four towns in Southern Finland were asked by questionnaire for their interpretation of the situation, how content they were with information provided and their perception of the risk from Russian nuclear power plants. Negative life events, psychological well being, anxiety and concern about health were studied.[2] An American paper describes a process designed to assess the potential health risks associated with adverse air quality in an urban industrial neighbourhood. A community used their powers to demand a professionally conducted community health survey, which was designed to document the health risk perceptions community members associated with exposure to adverse air quality in their neighbourhood. This survey served to legitimate the community's concern about air quality, and helped to broaden the definition of health.[3]

On the basis of this approach to risk assessment, we decided that it was essential to ascertain the viewpoint of people living in the index area. After some discussions with local people, we concluded that the most appropriate method was a postal survey. We knew, of course, that such a survey would be highly subjective. But the way people perceive risk is, by its very nature, subjective. Each person is entitled to an opinion, and the purpose of the survey was to ascertain opinions and perceptions. That is not to say

that all perceptions are true or even well founded. But it is important to understand the feelings, perceptions and opinions of people who are living in an area with a perceived cancer cluster.

2. POSTAL SURVEY OF THE INDEX AREA

Because of the large size of the index population we knew that it would be difficult to do a postal survey. Nevertheless, after discussion with the local committee it was decided that a postal survey was worth undertaking. From the start we were concerned that the response rate was likely to be very low. Therefore we saw the need to supplement the postal survey with a rapid appraisal exercise, and the findings are reported in the next section. Despite the clear logistical problems of doing a postal survey, it was felt advisable to go ahead with the questionnaires being delivered by the local municipality. The method of collecting the questionnaires was problematic. The council newsletter included a note asking residents to return the questionnaires to the municipality's offices. A special collection box was put in place near the Mayor's Office and completed questionnaires were inserted in this box for collection by the research team.

2.1 Developing a questionnaire

Following a meeting with the action committee, when key issues around the cluster were discussed, we developed a questionnaire, which aimed to ascertain the views and opinions of the risk imposed by the cancer cluster.

2.2 Data collection, response rate and analysis

Having obtained approval from the commissioner for data protection we were advised that the respondent should give us permission to analyse their questionnaires by signing it. We were concerned that such an approach would be another factor that would reduce the response rate. Around three thousand questionnaires were produced and delivered to each household in the index area. Unfortunately the response rate was extremely poor, and we only received 176 completed questionnaires. The research team made strenuous efforts to increase the response rate by walking from door to door and asking for completed questionnaires. These efforts were supplemented during the rapid appraisal exercise when the researchers talked to as many people as they could. It was clear from the information we gathered that the request to sign the questionnaire was a contributory factor in the low response rate. Data was entered into a statistical package (SPSS) and analysed by computer.

3. RESULTS

3.1 Characteristics of responders

Of the 176 adults who completed the questionnaire, 68% were males and 32% females. The age distribution showed that the majority of respondents were evenly divided between those aged 55 and over and those who were aged under 55. Only 8.6% of respondents had been born in the area. Around 17% of respondents had been in the area for less than 10 years and over a third (36.6%) for less than 20 years. Indeed, only a quarter of respondents had been living in the area for over 30 years. This finding is

significant as it shows that a large proportion of the population would have been exposed for a relatively short time period to risk factors in the index area. This is important as it is accepted that exposure to carcinogens has a long lead-time.

Table 1 shows the age sex breakdown of respondents. As the head of the household was asked to complete the questionnaire, two-thirds respondents were men. Among the questionnaires completed by women, just under two-thirds were in the younger age-group.

Table 1	Age sex breakdown of respondents					
	Male		Females		All persons	
Age group	N	%	N	%	N	%
20-54	55	45.8	35	62.5	90	51.1
55-80	65	54.2	21	37.5	86	48.9
All ages	120	100	56	100	176	100

3.2 Smoking history

Smoking was almost exclusively a male habit, with only nine females (18.0%) admitting to being current smokers – four smoking daily and five occasionally. Among the males, 21.4% smoked daily, 8.9% occasionally, and 34.8% were ex-smokers, leaving 34.8% who had never smoked.

3.3 Personal health

Most respondents described their general health as excellent or good (72.7%), 22.2% as fair and 4.3% as poor or very poor. However, there was a difference between men and women, as shown in table 2. Women, it seems, tend to be more pessimistic about their health. While over a quarter of men (26.5%) describe their health as excellent, only 13.0% of women do.

Table 2	Self perception of general heath by sex		
	Male (%)	Female (%)	All persons (%)
Excellent	26.5	13.0	22.2
Good	46.2	50.0	47.4
Fair	22.2	25.9	23.4
Poor or very poor	4.3	11.1	6.4
All	100	100	100

3.4 Electromagnetic radiation

In response to the question ‘are there any sources of electromagnetic radiation near your house, for example pylons of high tendency, mobile phone, radio and TV station aerials’ 21% of respondents answered yes.

3.5 Household and familiar cancers

Respondents were asked whether they, or any member of their household, had ever been diagnosed with cancer or leukaemia. Cancer was mentioned by 13 respondents (7.4%) and leukaemia by 2 (1.1%) of respondents.

A second question asked whether the respondent's family had a relative who had lived in the area and who had ever been diagnosed with cancer or leukaemia. Fifty respondents (28.5%) mentioned cancer and 6 respondents (3.4%) mentioned leukaemia. Two questions asked about the way in which the area compared with surrounding areas (table 3 and table 4). Around half of the men (53%) and just under two-thirds of the women (63.8%) think that there is a higher incidence of cancer in the index area. It's interesting to note the obvious sex difference in this perception. It is also worth noting that around half of the men who responded to the survey do not believe that there is a higher incidence of cancer in the area. It is interesting to note that more women are concerned about a higher incidence of cancer in the area.

Table 3 In your opinion, do you think that there is higher or lower incidence of cancer in the index area compared to surrounding districts?

	Males	Females
	Percentage	
Higher	52.9	63.8
About the same	42.2	31.9
Lower	4.9	4.3
Total	100	100

A similar pattern emerges in regard to pollution. While less than half of the men (41.6%) believe that environmental pollution is higher in the index area, 52.1% of women do.

Table 4 In your opinion, do you think that there is higher or lower degree of environmental pollution in your area compared to the surrounding municipalities?

	Males	Females
	Percentage	
Higher	42.1	51.1
About the same	53.3	44.4
Lower	4.7	4.4
Total	100	100

4. VIEWS AND OPINIONS ON THE INDEX AREA

Respondents were presented with nine statements and asked whether they agreed or disagreed. This idea was to present statements that dealt with the issue but which were relatively neutral. The findings are presented in table 5 on the next page. It is interesting that only half (50.7%) of respondents disagree with the statement that there is no cancer cluster in Kato Lakatamia, although another third (34.3%) were unsure. This means that of the respondents to this survey, around half are not convinced that there is a cancer cluster in the area.

The strongest opinion (76.8%) was that traffic pollution in the area was a major problem. Another major opinion was that asbestos pipes are a cause of health problems, with 72.6% agreeing with this proposition. In support of the two problems already mentioned, over 70% believe that environmental pollution has a significant effect on life

in the area. Just over half of the respondents (57.8%) feel that there are more cancers in the area than surrounding areas. Around a third of respondents (33.3%) think that there is land contamination in the area, and just over a quarter (27%) think that there is excessive exposure to electromagnetic fields.

4.1 Perception of health risk

To ascertain perceptions of health risk, respondents were presented with a number of factors that are known to have an adverse impact on health. Respondents were presented with a series of statements and asked to estimate how each factor might affect their personal health. The results are shown in table 6 on the next page.

Table 5	Opinion of respondent on the area of Kato Lakatamia				
Statement	Disagree ++	Disagree +	Neither	Agree +	Agree ++
	%	%	%	%	%
Environmental pollution has a significant effect on life in the area of Kato Lakatamia	0.6	2.4	16.4	35.8	35.2
There is a major problem with traffic pollution in the area of Kato Lakatamia compared to surrounding areas	0.6	7.3	15.2	39.7	37.1
There are more cancers in the area of Kato Lakatamia than the surrounding areas	0.6	4.3	37.1	32.1	25.7
People in the area get sick more often than elsewhere	1.8	8.7	51.4	23.2	14.5
To the best of my knowledge there is no cancer cluster in Kato Lakatamia	20.7	30.0	34.3	12.1	2.9
The population is not exposed to an excessive amount of radiation from electromagnetic fields	9.5	16.8	46.7	24.1	2.9
The use of asbestos pipes for the water supply to the houses is a cause of health problem in the area of Kato Lakatamia	0.7	3.4	23.3	44.5	28.1
There is land contamination in the area and this is causing health problems for the people of Kato Lakatamia	2.1	13.5	51.1	22.0	11.3
The general health of the people living in Kato Lakatamia is no different from people living in surrounding areas	10.4	23.6	30.6	31.9	3.5

The table shows that for each factor, with two exceptions, namely, excessive alcohol intake and being overweight, women perceive health risk as greater than men do. The risk factors identified by the highest proportion of women are electromagnetic fields from electricity power cables (79.5%), air pollution due to traffic fumes (76.1%) and daily smoking (73.2). For men the risk factors identified by the highest proportion are excessive alcohol intake (78%), follow by air pollution due to traffic fumes (70.5%).

Table 6	Perception of health risk	
	In your opinion how do you think the following factors might affect your personal health?	
	Males	Females
	Percentage who think the effect is very serious	
Occasional smoking	12.0	20.0
Daily smoking	67.0	73.2
Average alcohol intake	5.1	15.8
Excessive alcohol intake	78.0	65.9
High fat diet	54.3	58.5
Sedentary lifestyle	44.0	59.1
Electromagnetic fields from electricity power cables	62.0	79.5
Electromagnetic fields from household electrical appliances	17.0	35.9
Radiation from mobile phones	25.5	47.6
Being overweight	48.5	47.6
Driving and exceeding the speed limit	56.5	61.4
Air pollution due to traffic fumes	70.5	76.1

5. COMMENTS

1. The response rate was extremely disappointing, but perhaps not surprising. For people to respond to a postal questionnaire they need to feel strongly enough on the issue to take the time and trouble to complete the questionnaire. Yet, as we shall see from the rapid appraisal exercise, a large section of the population was unconcerned about the perceived cancer cluster. This lack of concern undoubtedly contributed to the low response rate. In retrospect, the length and complexity of the questionnaire probably discouraged the less committed section of the population from responding. Also the fact that data protection required residents to sign the questionnaire would have reduced the response rate.
2. There is little doubt that those who did respond would have more interest in the issue than the large number of non-responders. It is reasonable to assume that those who felt strongly on the issue were far more likely to respond. Therefore, there is a response bias that should be taken into account in interpreting the results.
3. In general women tend to be more pessimistic about health risk. There is a high degree of concern about the apparent health risk of electromagnetic fields.
4. Many people still believe that asbestos water pipes pose a health risk.

1 Environmental Health, 18th edition, ed WH Basset 1999, London, article, 'Risk assessment and risk management by L Falconer, N Ford, K Ray, D Rennie. Publ. E and FN Spon. p198.
2 Eranen L. Finnish reactions facing the threat of nuclear accidents in Russian nuclear power plants. Patient Education & Counseling. 30(1):83-94, 1997 Jan.
3 Elliot SJ et al. The power of perception: health risk attributed to air pollution in an urban industrial neighbourhood. Risk Analysis. 19(4):621-34, 1999 Aug.

Section 7

Rapid appraisal exercise of Lakatamia

1. INTRODUCTION

During the period between January and April 2005 we conducted a rapid appraisal exercise within the index area. Rapid appraisal is a useful technique to supplement the findings of the medico-social survey. The idea was to ascertain the views and opinions of local people who have first hand knowledge of the social and health problems of their own local community.

We were aware that the perception that there was a cancer cluster in Lakatamia had received a great deal of media coverage. The purpose was to ascertain the views and opinions of the people living in the area of the cluster. The idea was to hear first hand from people what they thought about the perceived cancer cluster. What were the real concerns of the people? How deep was the anxiety about the cancer cluster? What, if anything, did they think was the cause of the excess cancers?

2. METHODOLOGY

We followed the well-described principles of rapid appraisal. The plan was to ask a number of key informants and residents about their view of health issues within the area, and more particularly their concerns about cancer. We also set out to ascertain how people had become aware of the perceived cancer cluster. As far as possible we let people express their views and concerns in their own words, and where necessary we prompted them with leading questions. We asked all informants whether they were concerned about health in the area, and whether they were concerned about cancer. Those who were concerned about cancer were asked whether they were aware of the perceived cancer cluster and how they had heard about it. We worked as a pair, one investigator asking questions in Greek, and the other recording the key messages that emerged from each interview. The interviewers discussed all the interviews and agreed jointly on the main themes that emerged from the rapid appraisal exercise.

3. GEOGRAPHICAL AREAS COVERED

Following a review of the index area, we divided it into six sections for the purpose of the rapid appraisal exercise. Interviews were carried out in each area.

3.1 Area 1 – Near the Mayors Office

We interviewed around 10 people living in houses near the Lakatamia Municipality Offices. General views and opinions were gathered. There was a consensus that there was no real concern about the general health of the people living in the area. Only two or three people spontaneously mentioned the cancer scare. However, when asked directly, most people said that they had heard that there was a problem with cancers in the Paraskevi area, but most did not believe that their area was affected. Most people we spoke to identified Mr Poumos as the person most likely to know about the cancers

and told us to speak to him to get more information. A number of men said they had heard discussions in the coffee shops about cancers. It was fair to say that there was very little anxiety.

3.2 Area 2 – Around the Church of Ayia Paraskevi

This area is to the left side of the main road on the way out of town. We spoke to around 20 people in this area.

We spoke to an old man aged 82. He was not well at the time, suffering with a throat problem, which was causing some discomfort, for which he was receiving medical treatment. He said there were no concerns about cancer or the environment that he was aware of. He had not heard about a cancer cluster.

We then spoke to an old man aged 73. He had no personal health concerns or environmental concerns about the area. Although he had heard talk about cancers but he was not himself worried. A little while ago most people had thought that cancers were caused by asbestos in the water. Things have now quietened down and most people are not so worried any more.

We were invited into the home of a lady in her sixties who had serious health problems. She said she had breast cancer and was worried about a mobile phone mast near to her house. Her cancer was diagnosed more than 10 years ago and she was being followed up annually. She said that lots of people in the area died from cancer. She mentioned that 4 or 5 had died in her road from cancer. People were worried about the water supply and this meant that people did not drink the local water. She was worried about children playing in the street and felt that the mobile phone mast situated about 100 metres from her home, could have an impact on their health. She knew of a woman aged 39 who had recently died from cancer.

A man aged 65. He said that people in the area were worried about cancer and especially about asbestos pipes and the water supply. He also mentioned a battery factory near Ayios Mamas that had produced lead. He said there were too many cancers in the area and there was concern about environmental factors. He knew of a woman who died of cancer of the uterus 7 years ago.

A middle-aged husband and wife who were both refugees and lived in Pericleous Road. They said that people were generally worried about cancer and leukaemia in the area. They had heard rumours about cancers and people had been on the television talking about cancers in the area. Although they did not know about any one with cancer, they had heard lots of talk. In the past, TV programmes had focused on the environmental issues and problems associated with asbestos pipes. They thought that the TV programmes generated a lot of the talk.

A couple aged in their seventies who were both refugees. They did not know anybody who had suffered from cancer in the area, but they had heard a lot of gossip about

cancers. They had no worries about environmental factors and said that the area was generally peaceful and quiet. They were not worried that house prices were affected by this talk. He said that most people in their road were refugees.

A man aged 77 also in Pericleous road. He said there were health problems in the area and he himself suffered with Parkinson's disease. He lived by himself but did not know anything about cancers. A lady aged 68, also in Pericleous Road. She lived on her own and said she had not heard about health concern or about cancers.

We spoke to two young men and they had not heard about cancers in the area or about other environmental problems. We spoke to a husband and wife in their sixties. They heard of concern about cancers and environmental factors from TV. They said there was discussion about asbestos cancers causing cancer and some concern about electromagnetic fields. They said that TV programmes on the news often carried stories about cancers and other programmes raised public awareness about cancer.

A middle-age man in Costa Andreou Street. He lived in the area for many years and said there were lots of cancers in Lakatamia. His son in law died from cancer aged 32 about 10 years ago. Last year a neighbour living in the same road died from cancer and a woman living opposite his house died from cancer less than a year ago. He said there was lots of talk about asbestos pipes and people generally gossiped a lot about cancer.

A man in his sixties, just off Costa Andreou, said he heard all the stories about cancer but could not be sure if they were true. He said that two people had died from cancer living nearby – a man age 56 and a woman aged 48. There was concern about asbestos pipes that might be the cause of the cancers and people became aware through discussions in coffee shops, discussions between neighbours and television programmes and from Mr Poumos. He said that there had been a number of TV programmes that dealt with cancer in the area.

Another man nearby knew of a woman who died from cancer that lived down the road. He had heard about the incidents of cancer in the coffee shops and people were worried about asbestos pipes.

A man in his 50s had heard of lots of cancers in the area and he knew of two or three cases personally. He said a group, led by Mr Poumos, had formed a lobby to raise concern about cancers. They collected information about the many people in the area who had died from cancer.

Then we spoke to a man aged 72. He knew of lots of cancers in Lakatamia, which he had heard about in the coffee shops. He said that every time the church bell rings for a funeral people gossip about the cause of death, and this made many people aware of cancer. He was not aware of any environmental problems in the area. He had not seen TV programmes about cancer in the area

Moving into the main road we spoke to a lady in her late forties. She knew of problems with cancer and mentioned a number of cases. However, she mentioned other environmental factors that she was worried about.

Themes for this area

In this area there were a number of people who had concerns about cancer but equally there was a group who knew about the discussion but had no anxiety about health problems in their area. The TV was seen as a dominant factor in influencing people's views and opinions about cancer. Many people said that they had seen TV programmes that made them believed there was a problem with cancers.

There was also a lot of talk in coffee shops about cancers in Lakatamia emanating from the rumours and discussion following TV programmes. The ringing of church bells each time there was a funeral appeared to generate discussion about the cause of death, and raised concern about cancer. The name of Mr Poumos was mentioned fairly frequently as the man who knew about all the cancer cases in the area.

Asbestos pipes was the most common factor mentioned by the residents area as a main cause of cancers and the fact that people were now switching to bottled drinking water.

3.3 Area 3 – Koullaratos Area

We spoke to husband and wife in their sixties. They said that all this talk about cancer was not valid. There was a lot of agitation in the area. In their view people were influenced by one another and talk about asbestos pipes which are causing cancers. They were not aware of cancers in the area. They believed that the campaign run by Mr Poumos was the main source for the anxiety that some people felt about cancers.

Then we spoke to a man in his seventies. He offered said that people in the area were not worried about cancers. However, he acknowledged that there was anxiety about cancer from asbestos in other areas and he knew that some people in the area of Ayia Paraskevi had died from cancer. However there was no concern in this area.

Then we spoke to a husband and wife in their home. They had heard about a problem with asbestos pipes in the area and they picked this up from discussion around the area. As a consequence they had started drinking only bottled water. They had heard about cancers near the Ayia Paraskevi Area from Mr Poumos.

Themes from this area

Generally there was little or no concern about cancers in their area. However they had all heard about cancers in Ayia Paraskevi and they all recognised Mr Poumos as the man who knew what is going on. Almost without fail they mentioned asbestos pipes as a topic of discussion in the area.

3.4 Area 4 – Ayios Mammas

In Kitiou Street we spoke to a young lady. She had no knowledge of cancer and the main problem that worried her was to do with the sewage system.

We spoke to two ladies, one in her forties and one in her seventies. There was no problem with cancers in this area but they had heard the gossip from the grocery shops about cancers in Ayia Paraskevi. The main worry was about asbestos pipes.

Then we spoke to a lady in her sixties and she said there was no health problem in the area. She was unaware of any problems with cancer in this area.

We spoke to man and wife in their forties. They were refugees and they had no worries about cancers in the area, although they had seen programme on TV that spoke about cancers but not in their area.

Then we spoke to a man in his forties, a refugee. He had heard people talking about water pipes and he had seen a programme about water pipes but there was no worry local worry about cancer.

We spoke to a man in his seventies and he said there were no specific health problems in Ayios Mammas. In fact, he said there were more health problems in England. He said there might be problems with cancer in Ayia Paraskevi but not here. He had seen TV programmes about cancers in Lakatamia.

We spoke to a lady in her seventies and she said there was a big problem with noise from dogs in the area, but there was no serious health problem that she was aware of. She said that she had heard that in Lakatamia they had problems with asbestos pipes and cancers. People said pipes make a lot of noise and they want all the water pipes changed.

We spoke to a lady in her sixties and she had not heard about health problems in Ayios Mammas but there were problems in Ayia Paraskevi and she had seen TV programmes talking about cancers. She said the main problem in the area is that there is a lot of old people and they have the usual health problems of old age. People were not really worried about cancers.

We spoke to a group of 7 men in a coffee shop and they said the main problem in the area was alcohol. They also said there was a lot of heart disease in Ayios Mammas. They heard there was talk about cancers in Lakatamia, but one man said that he did not believe that pipes caused cancers. He felt that the cancer scare was exaggerated. Nevertheless some people do not drink water from the pipes but buy bottled water for their own consumption.
We spoke to the Council Leader of Ayios Mammas, Andreas Pericleous, in the coffee shop. He had a very clear assessment of the problems in Ayios Mammas. First, he

said there were lots of problems related to old age as the age structure of the people was becoming increasingly old. This was aggravated by the Government policy in that it did not bring new and young people in to the area and this led to an imbalance in the age profile of the population. Another major problem was that some people have housed in the Occupied north and they migrate between the two areas and this was unfair on the other locals. Their houses could stand vacant for long periods of time.

He said there was no real problem with cancer in the area, although he knew of 5 or 6 people who had cancer, but they were all old, as one would expect. In summary the main problem in the area was deprivation and old housing and people in the area do not complain about cancer. He had heard about the cancer scare in Ayia Paraskevi. The government is not doing anything to repair old housing, leaving it in a dilapidated state.

Themes for the Area of Ayios Mammas

The Council Leader summed these up well. First, there is no local concern about cancer. In fact not a single person we spoke to said anything about cancer although most had heard about Ayia Paraskevi. Second, there was concern about the ageing of the population in the area. Third, many people had heard about the problems arising from TV programmes airing views on causes of cancer in the area. Four, Mr Poumos' name came up during the discussions as a source of knowledge about cancer incidents.

3.5 Area 5 – The area of Archangelos

We spoke to a young man in his thirties and he was unaware about any health problems in the area and he knew of no cancers in the area and knew nothing about public concern of any problems of this kind.

We spoke to a man in his forties and he said there were no local health problems. He had heard about cancer problems in Ayia Paraskevi and he had seen TV programmes about cancers in Lakatamia. He was unaware of any local concern about cancer.

We spoke to a young lady in her twenties and she said that people talk a lot about cancers and someone in the area had died from cancer in the area four months ago. People were concerned about pollution and traffic.

Then we spoke to a lady in her sixties. She was unaware about specific health problems in the area and she was unaware about any specific problems with cancers. She also had no concerns about local environmental issues.

We spoke to a lady in her fifties and she mentioned and she mentioned the battery factory that had closed a few years ago. She said that people in Lakatamia died from cancer but not here. There were no local worries about health or cancer.
We spoke to another lady in her fifties who said that there were no problems in the local area, but she had heard from people in Ayia Paraskevi that they had cancer

problems. There was a lot of gossip about Ayia Paraskevi and she had seen TV programmes about cancer.

General themes of the area

There are no health problems of concerns and no local concern about cancer in this area, although people on the whole had heard about cancers in Ayia Paraskevi and they had seen TV programmes about cancer.

3.6 Area 6 – Ayia Paraskevi Triangle

The Ayia Paraskevi triangle is an area around on the opposite side of the road from the church consisting of a number of roads that it is alleged there had been excessive incidents of cancer. The roads when viewed together formed a triangular shape on the map and we therefore named it the Ayia Paraskevi triangle. We made specific effort and tried to visit and speak to as many households as possible in this area.

Nikou Alexandrou Street

We spoke to a middle-aged lady. She was concerned about cancers in the area and thought that the possible causative factors were two factories. One factory produced plastic gloves and she used to get the smell in her house and the other produced batteries. She also mentioned that she thought that the main causes of cancers in the area were the asbestos pipes. She also thinks that the road traffic was a major problem. The woman who lived opposite had Hodgkin's disease and her aunt had died from cancer of the brain 10 years ago. She knew of a number of cancers in the area.

We spoke to an old lady who lived in the area (same street). She knew of lots of people who had cancers, in fact she mentioned 6 people with cancer in the small Poumos Triangle. She knew of no environmental problems in the area and she knew of no electromagnetic fields in the area. She thought the asbestos pipes were not causing a problem. She also thought that the diet was a possible cause of cancer.

We spoke to a lady aged in her seventies (same street). She said there were many cancers in the area and every other house right up to the church had had a cancer. She thought that the army camp during the war might be a factor. She said people talk a lot about the asbestos pipes.

Then we spoke to another lady (same street) and her two daughters. They had lived in the area from many years. They said that they talk about cancer every day. They mentioned a number of cancers in the area and thought that the army camp could be a factor. They also told us about two cases of prostate cancer that lived nearby; one of those had been treated in England. Then we spoke to a lady aged 61 who said her sister died from cancer of the bowel 5 years ago. She said she did not want to talk any more. Spoke to a lady aged 85 who said she did not know anything about cancers.

We spoke to a lady aged in her 70s. She said she knew of 3 or 4 cancers in the area and people talk a lot about the asbestos pipes. One person had died from cancer of the sternum. She then said that cancers occur everywhere; not only in Lakatamia and in her opinion she did not think that the incidence of cancer in Lakatamia was worse than anywhere else. She said that in her opinion some of the stories about cancer were made up.

Common themes of the area

There was a lot of concern in the area about cancers. People talk a lot about cancers and they tend to reinforce each other's ideas. Most people supported Mr Poumos' campaign. Common concerns were about asbestos pipes and also the army camp. However, one lady in this area was clearly sceptical about the whole thing.

4. THE POUMOS INTERVIEW

We met and spoke to Mr Poumos in his house, which is near his shop and facing the main road. He started by giving us his version of cancer statistics.

He said that of the 33 houses in the triangle around his shop 24 have had cancers. He said that of 30 people in the triangle have had cancers and 18 have died from cancers. In one house there have been 3 cancers. Speaking about mortality in the area (33 houses) 28 people have died in the period 1997 to 2005 of which 10 died from old age and 18 died from cancers and he knew all of these people. He then described clusters that were gathered around the Makarios Avenue extending around 100 meters on either side of the road. He mentioned the asbestos pipes and very high traffic flows in a narrow road, which was one on the main causative factors.

5. PLACES REVISITED IN JUNE 2005

At this stage of our investigation and having analysed all the information we collected we formed the view that the area of most concern was a small geographical area around Mr Poumos' shop. There were significant differences in opinions between this small triangular area and the rest of the index area. For this reason we revisited the index area and spoke to approximately 20 people in other geographical spots chosen at random. We also revisited the "Poumos triangle area" at this time in order to make comparison. The analysis of the information gathered during this visit provided us with a very similar picture to the previous analysis.

6. OVERALL THEMES

6. 1. Geographic difference in views

It is clear that there is a considerable difference in opinion between the six areas. The highest level of concern about cancers is in the Poumos Triangle, where people spend a lot of time talking to each other about their concerns about cancer. In this triangle people all knew about each case of cancer, and were convinced that there was a very high incidence of cancer in the area. However, one lady was unconvinced, and thought that there was a large element of hysteria about the whole thing.

In the area around the church on the other side of Makarios Avenue, there was also a fair level of concern, but not of the same order of magnitude as in the Poumos triangle. In this area probably an equal number of people did not have any real concerns about cancer. Therefore there is a mixture of opinion, some expressing concern whilst others did not.

Moving to the other four areas there was little or no concern about cancer, although in each of the areas people were aware of the problems in Ayia Paraskevi. The majority of people were adamant that there were no problems in their area, and were largely unconcerned about the perceived cluster, which they did not see as their problem. This low level of concern undoubtedly contributed to the low response rate to the postal survey.

In conclusion it is fair to say that real concern over a perceived cluster is confined to a very small geographical area.

6.2. Sources of perceptions

We identified a number of ways in which people had become aware of the cancer problem. The first, and most important, is the campaign that was being run by Mr Poumos, and this influence was especially powerful near to his shop (in the Poumos Triangle), and to a lesser degree in the area on the other side of the road. Many people told us that the Poumos campaign was having a significant influence on their opinion.

Another source of influence is the television. So many people had seen television programmes and that discussed the issue of cancer in the area. Many said that these programmes had had a strong influenced on their opinion.

Quite a few men said that they had heard discussions about cancers in the coffee shops.

One perceptive person identified ringing of church bells for funerals as a factor that made people talk about cancers.

6.3. Reasons for the cluster

The most widespread theory was that the main cause of cancer in the area is the asbestos pipes, which carries water to the houses. This was mentioned almost everywhere we went, although some people were sceptical. However, a number had stopped drinking tap water because of the cancer scare.

Traffic and environmental pollution were mentioned as other possible causes of cancers. One lady mentioned the mobile phone mast as a cause. No unexpected environmental factors were mentioned.

Section 8

Analysis of Dioxins and PCBs in human milk

1. INTRODUCTION

The dioxins and related compounds are among the most intensively studied chemicals in modern occupational and environmental health. Because of their widespread dispersal into the environment and because of their resistance to physical and biotic breakdown, most people and animals tested carry measurable levels of these chemicals.

Contrary to popular usage, 'dioxin' is *not one compound* of a single, defined toxicity, but a *family of compounds* consisting of 17 dioxins and furans and 13 PCB members of widely ranging toxicity. Whether it is formed as an unwanted by-product of industrial processes, in a barrel of burning trash, or in a forest fire or volcanic eruption, what we call 'dioxin' is really a complex, variable mixture of dioxin, furan and PCB components.

There is now regulatory concern over the possible adverse health effects of chronic exposure to trace levels of persistent organic pollutants. The class of compounds collective known as dioxins, has received widespread attention and attracted a great deal of research, following the accidental release of the most toxic of these compounds at Seveso in 1976.[1]

Dioxins have never been manufactured for commercial purposes. They are formed in trace amounts in a variety of combustion environments, both natural (e.g., forest fires and volcanoes) and those controlled by man (e.g., energy generation, chemical manufacturing, backyard trash burning, vehicle fuel combustion and various types of waste incineration). Government regulators, industry and environmentalists have worked hard to reduce emissions of dioxins to the environment. The Environment Protection Agency in the USA estimates that pollution control efforts have resulted in declines in emissions of 92 percent between 1987 and 2004.

Many regulatory authorities have issued health guidance statements regarding the dioxins. Most of these statements are based on assessments of the risks of these chemicals as carcinogens, calculated from studies in rodents. The difference among them – several orders of magnitude – arises from different assumptions as to the most appropriate way to estimate risks of chemically induced cancers at low levels of exposure, well below the range of doses used in studies of animals or experienced by occupational populations.[2] Some of the most heated controversies in public policy involve the assessment of the human health risks of these compounds. Any review of this topic must note the important interplay of science and politics because of implications for legal liability and for regulatory action by government.[3]

According to the report of the EU on dioxin exposure and health data, 'due to the complexity of studying the effects of trace doses of a mixture of chemicals, there is considerable scientific debate about the acceptable level of exposure to dioxins. There is uncertainty about the mechanism of action of the compounds, in relation to causing a range of physical effects in humans and animals, and the alternative interpretation of the available data have led to significant differences in the recommended tolerable dose – notably between the United States Environmental Protection Agency and the World Health Organisation.'[4] Indeed, there was a large difference in the recommended safe daily intake. The WHO recommended a daily intake of not more than 10 pg 2,3,7,8 TCDD whereas the EPA advocated a daily intake of less than 0.006 pg/kg body weight.

2. HEALTH EFFECTS OF EXPOSURE TO DIOXINS

There is no reliable information on safe or no-effect levels of exposure for human health. The risks of current exposures are unknown. On the basis of the precautionary principle, at present, most public health authorities advocate a highly prudent approach to estimating the human health risk of dioxins, and many countries have imposed occupation and environmental regulations designed to reduce exposures. Levels of dioxins are measured as TEQs (toxic equivalency quantities, a toxicity weighted sum of dioxins and furans).

3. EXPOSURE FROM BREAST MILK

Exposure to dioxins can occur via ingestion, inhalation, and absorption through the skin. These chemicals can also be transferred across the placenta and are secreted into the breast milk. Absorption through the intestinal tract is very efficient especially when dioxins are in milk or fatty foods.

Dioxins are known to be ubiquitous in the environment and the entire population of the European Union has, to some extent been exposed to dioxins primarily through the ingestion of contaminated foodstuffs, although accidental and occupational exposure can also occur. Dioxins accumulate in the body and the average concentration increases progressively from year to year. Concentrations have been measured in the breast milk.

3.1. Levels of dioxins in breast milk reported by EU study

The main source of comparable data for the majority of European States was the WHO co-ordinated assessment of dioxin concentrations in breast milk, the first round of which was conducted during the period 1986-1988 and the second during 1992-1993. The baseline concentration was taken to be that of the average female population, which had not been subject to any known accidental or occupational exposure to dioxins.[5]

In the case of the WHO assessments, analyses were performed on pooled milk samples, composed of varying numbers of individual samples, and the average concentration for the pool was reported.

The results of the WHO study of EU Member States is shown in table 1

Table 1	Average reported concentrations of dioxins in human breast milk per pg i-TEQ/g fat					
	1988			1993		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Rural	28.2	18.6	37.4	17.7	10.9	24.5
Urban	29.5	17.1	39.6	19.2	10.7	26.6
Industrial	35.9	31.6	40.2	24.0	20.9	27.1

3.2 Levels of dioxins reported in Australian study

An Australian dioxin breast milk study was carried out as a part of the Nation Dioxin Program for the Department of the Environment. The study collected 173 pooled samples during October 2001 and September 2003. The study was skewed as it only accepted mothers with healthy pregnancies and the samples were pooled.[6] Dioxins were detected in all pooled samples, with mean and medium levels, expressed as TEQ, of 9.0 pg WHO-TEQ g^{-1}.

For samples collected in 1993, the mean level expressed as TEQ were 16 pg WHO-TEQ g^{-1}.

4. COLLECTION AND ANALYSIS OF BREAST MILK FROM LAKATAMIA

We collected 10 samples of human breast milk from volunteer mothers who are breast-feeding. Seven of the ten mothers were breast-feeding their first child and the other three their second child. All mothers selected to provide samples of breast-feeding milk have had a normal physiological delivery and have lived in the area for longer than the required minimum of the preceding six months.

Participating mothers were asked to complete a standard WHO questionnaire and provided their written consent before they are selected to provide bread milk samples. All the participating mothers were given special instructions by the Occupational Health Nurse, of the Ministry of Health, for collection of samples and they were provided with individual breast pumps. Our Specialist laboratory provided the instructions for the mothers.

4.1 Sample handling

SAL Scientific Analysis Laboratories Ltd, Manchester, United Kingdom provided clean borosilicate sample bottles for sampling and cool boxes for transport. A minimum of 50ml of each sample is required, but more sample was collected in the event where re tests were required. The sample can be accumulated over several days provided the collection bottle is maintained chilled in a refrigerator. Each sample needs was identified using a unique code. This was written on the sample bottle and on the accompanying chain of custody. Samples were packaged securely in a cool box to prevent movement during transportation.

4.2 Analysis

Analysis of the breast milk was conducted using HRGC/HRMS according to methods based on US EPA 1613. QA/QC procedures are conducted throughout the analysis using isotope dilution techniques to monitor recovery and enable qualification. If recoveries fall outside the acceptable range, analysis was repeated.

External performance checks are maintained by routine participation in inter-laboratory trials/schemes such as FAPAS. The basic performance criteria established for the testing of foods and feeds are in line with those proposed in the EU Directives 2002/69/EC, 2002/70/EC and Council Regulation 2375/2001. All the analysis carried out was within the scope of accreditation by the United Kingdom Accreditation Service (UKAS)

The average age of participating mothers was 27 years; the average weight of the babies was 3040 grams; average height 163 cms; average weight 71.9 kilograms.

A summary of the results is presented in table 2 below:

Table 2	Average reported concentration of dioxin in human breast milk for pool sample of 10 women from Lakatamia			
	WHO toxic equivalents			
	Lipid weight based		Total volume	
	Detected	Upper Bound	Detected	Upper Bound
	ng/kg	ng/kg	Ng/kg	ng/kg
Dioxins	1.05	3.04	0.02	0.05
PCBs	5.20	6.69	0.09	0.13
Total	6.24	9.73	0.123	0.18

The average WHO TEQs was 6.2, which is well within the values reported by both the EU and the Australian studies. The upper and lower values are presented in table 3.

Table 3	Range of reported concentration of dioxin in human breast milk sample of 10 women from Lakatamia							
	WHO toxic equivalents							
	Lipid weight based				Total volume			
	Detected		Upper Bound		Detected		Upper Bound	
	ng/kg		ng/kg		Ng/kg		ng/kg	
	Range							
	Low	High	Low	High	Low	High	Low	High
Dioxins	0.0	2.7	1.3	8.8	0.0	0.053	0.023	0.076
PCBs	0.58	25.0	3.0	25.0	0.006	0.58	0.057	0.58
Total	0.58	27.7	5.4	28.8	0.01	0.62	0.05	0.65

The highest value detected was well within the range reported by the EU study.

The detailed results can be found in the report from SAL Scientific Analysis Laboratories. This is a 48-page report and is shown as Appendix 2.

In a brief description the summary of the results of Dioxin and PCB for each of the ten participating mothers are shown on pages 2 to 4. Pages 5 to 16 show the detailed analysis of individual dioxin and furans. The detailed analysis for PCBs is shown from page 17 to 28. Pages 29 to 48 show the details of the details of the completed questionnaires of the mothers who provided the milk samples.

5. CONCLUSIONS

1. The pooled average total dioxins (6.2 WHO TEQs) found in a sample of ten mothers resident within Lakatamia are lower than the levels reported in the EU and Australian studies.
2. There is no evidence of a significant environmental exposure to dioxins in Lakatamia.

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1 Compilation of EU Dioxin Exposure and Health Data, Summary Report produced for European Commission Environment, October 1999

2 Ellen Silbergeld and Valerie Thomas, Dioxins and related compounds, cited from *Environmental & Occupational Medicine*, third edition, edited by William Rom, 1998, p1186

3 Ellen Silbergeld and Valerie Thomas, Dioxins and related compounds, cited from *Environmental & Occupational Medicine*, third edition, edited by William Rom, 1998, p1185

4 Ibid. Compilation of EU Dioxin Exposure and Health Data, Summary Report, p1

5 Compilation of EU Dioxin Exposure and Health Data, Task 5; Human tissue and milk levels. Report produced for European Commission Environment, October 1999

6 Jochen Muller, Fiona Harden et al. *Determination of the levels of dioxins and dioxin-like compounds in the Australian population by analysis of pooled human breast milk*, Technical Report No 10.

Section 9

Electromagnetic field measurements

1. INTRODUCTION

TUV Product Service were commissioned to perform an electromagnetic field survey as part of the medical research study on the assessment of adverse health effects on the population of Kato Lakatamia from environmental and other factors. The research team had identified 20 houses at addresses in Lakatamia based on an agreed protocol and the permission of the house owners to perform the electromagnetic field measurements was obtained.

For each house measurements were made in each room within the house and at external locations outside the house. Diagrams of the external and internal locations were recorded and are presented in the full survey report, which is shown in Appendix 3.

Local sources of electromagnetic fields such as high voltage power lines on overhead pylons and cellular phone base stations on masts were visually identified and their distances from the measurement locations recorded

Measurements were made at a height of one metre and generally at the centre of each room and at external locations on the boundary of the property closest to any visible electromagnetic sources. The address of each location was recorded and in addition the GPS co-ordinates recorded (latitude and longitude). Time of day, date and weather conditions was recorded.

For each house, measurements were made with electrical power switched on and with those electrical appliances switched on that were already in use. In some cases electrical appliances were switched off to determine their local field contribution. The purpose of the electromagnetic field measurements was to measure the environment throughout the house to which the occupants would be exposed. The measurements were not intended to measure the localised fields around electrical appliances, as these were not representative of the occupied environment

2 SURVEY TEST METHODS

The specific test method adopted provides continuous coverage of the frequency spectrum from 5Hz to 18GHz and encompasses all likely electromagnetic sources.

At lower frequencies (below 400kHz) both magnetic field and electric fields were measured. The frequency range up to 400kHz encompasses the fields due to power line fundamental frequency (50Hz) and harmonics. Magnetic and electric fields need to be assessed separately at these frequencies, as their values are unrelated to each other. At higher frequencies the electric and magnetic fields are related by a constant factor and therefore only one needs to be measured. In this survey only electric field was measured from 400kHz up to 18GHz.

The test probes used were "isotropic" so that they responded to electromagnetic fields from any direction, with the exception of one probe (electric field below 400kHz) that

was a single axis probe that required three measurement orientations to determine the worst case.

3. ELECTROMAGNETIC FIELD EXPOSURE AND GUIDANCE DOCUMENTS

Countries adopt guidelines as a means of restricting exposure of people to electric, magnetic and electromagnetic fields. These guidelines are based on the findings of experts and researchers in the field of radio frequency safety and adopted by governments, professional bodies etc. Some relevant bodies and their guidelines are described below.

The International Commission on Non-Ionising Radiation Protection (ICNIRP) are part of the Environmental Health Division of the World Health Organisation (WHO). ICNIRP have prepared a set of guidelines known as ICNIRP 1998.

Within the European Union and under the Treaty of Rome, the issue of public health remains the responsibility of individual member states. The European Council has however provided a Council Recommendation 1999/519/EC. The exposure levels recommended for general public exposure are identical to the ICNIRP 1998 Guidelines.

In the workplace, the EU has adopted the Physical Agents Directive (Electromagnetic Fields) to protect workers from exposure to electromagnetic fields. Member states have until 2008 to implement national regulations to enforce the Directive. The levels in the Directive are identical to the occupational levels in the ICNIRP 1998.

Within the UK, the National Radiological Protection Board (NRPB), who is now part of the Health Protection Agency, have since 2004 also adopted the ICNIRP 1998 Guidelines in their recommendation, Volume 15 Number 2.

3.1 Basis of Electromagnetic Field Guidance

The non-ionising radiation guidelines cover the entire frequency range of non-ionising radiation that is defined as frequencies up to 300GHz. In practical terms there are no sources of non-ionising radiation in the environment above 18GHz, therefore the survey was limited to this frequency.

Non-ionising radiation does not have sufficient energy to cause ionisation of materials and the main effect is that of heating of tissue due to energy transfer and some minor effects on nervous system functions due to current density. In the case of people, the heating effect must be limited to that which can be safely controlled by the body's thermo-regulatory system and allowances made for certain organs (the eyes and testes for example) that do not have efficient thermo-regulation. The guidelines also take account of the coupling mechanisms including body frequency resonance and depth of penetration of tissue with frequency.

In addition to the heating effect of non-ionising radiation, there is much research investigating possible biological effects including cancer, the subject of the medical research study for Kato Lakatamia. The research is generally focussed in two areas: the effects of low frequency power line magnetic and electric fields and the effects of radio frequency telecommunication devices such as mobile phones. To date, none of the guidance making bodies has found evidence to form a basis for limiting

electromagnetic exposure due to the incidence of biological effects. For example within the UK, all available research was reviewed by the National Radiological Protection Board in 2004 and is available in the NRPB publication Volume 15 Number 3 (available from the UK Health Protection Agency website).

The ICNIRP Guidelines for non-ionising radiation are therefore concerned with limiting the heating effects of non-ionising radiation and the induced current density at low frequencies. The guidelines provide "basic restrictions" for levels of current density within the body and the Specific Absorption Rate (SAR) of energy within tissue. Since these basic restrictions occur inside the body they are extremely difficult to measure directly and can only be measured using artificial (phantom) heads or torsos. Test methods are available for assessing mobile phone SAR in a laboratory environment using a phantom head.

4. SURVEY RESULTS

A full report with survey results is attached as Appendix 3. A brief description of the summary results is shown in table 1 below:

Table 1	Summary of electromagnetic field measurements		
House No	Internal & External Electromagnetic Field, 5Hz to 18GHz - worst case result as a percentage of ICNIRP 1998 Reference Levels (Note 1)	HV Power Pylons Visible	Base station Mast Visible
1	0.7%	Yes	No
2	18.4% (Note 3)	Yes	No
3	4.3%	No	Yes
4	5.7%	No	Yes
5	2.9%	Yes	No
6	2.1%	Yes	Yes
7	2.1%	Yes	Yes
8	3.3%	No	Yes
9	0.6%	No	No
10	1.1%	No	No
11	1.5%	No	No
12	**5.4%**	No	Yes
13	0.9%	No	No
14	1.2%	No	No
15	0.7%	No	No
16	1.1%	No	No
17	**4.6%**	No	Yes
18	3.6%	No	Yes (Note 2)
19	0.6%	No	No
20	1.36%	No	No

Notes

1: ICNIRP 1998, Reference levels for general public exposure
2: American Radio Installation
3: Due to external electric field from adjacent HV power lines

5. CONCLUSIONS AND RECOMMENDATIONS

The survey concludes that none of the 20 addresses surveyed exceeded the reference levels for general public exposure given in the ICNIRP Guidelines 1998 or the European Council Recommendation 1999/519/EC.

Therefore it can be concluded that there are no electromagnetic field hazards to people at the addresses surveyed.

5. 1 High Voltage Power Lines

The maximum electromagnetic field found at an address was 18.4% of the ICNIRP Guidelines at address 2. These fields were due to 50Hz HV power lines that were less than 20m from the boundary of the property.

Additional measurements were performed under HV power lines 40m from address 1. The electromagnetic fields under the power lines were a maximum of 30% of the ICNIRP Guidelines.

Considering the results of measurements in the vicinity of HV power lines it is recommended that local planning policies take account of the potential electromagnetic fields from HV power lines and do not permit buildings under power lines (especially multi-storey buildings).

5. 2 Base Station Masts

Several addresses were in the vicinity of mobile phone base station masts as shown in the results summary, but were not exposed to significant levels (5.7% or less of the ICNIRP Guidelines).

It is recommended that the findings of the UK Independent Expert Group on Mobile Phones should be considered for local planning of future base station masts. The IEGMP are also known as the Stewart Committee. Their recommendations include:

- Planning controls should be applied to base station masts of any size
- School buildings & playgrounds should not be in the main beam
- Physical barriers and signs are required around masts

Section 10

Discussion, conclusions and recommendations

Having considered all the information presented in this report, we must now address the central question. Is there a cancer cluster in the index area of Lakatamia, namely Ayia Paraskevi and Ayios Mammas? To answer this question we need to consider the issue of the perceived cluster in context, taking account of all the evidence.

1. A STATEMENT OF THE PROBLEM

The perception that there is an excess of cancer in Ayia Paraskevi started around 1997, when a few people noticed that a large number of locals were dying from cancer of the large bowel. In the absence of any obvious cause, asbestos water pipes were seen as the most likely explanation for this perceived excess of large bowel cancers. There were newspaper stories of an epidemic of cancers in Ayia Paraskevi. Reports in newspapers and TV programmes, quoting poorly validated figures, encouraged the idea of a cancer epidemic. The local residents committee *Agonas*:

> We insist that there is an epidemic of cancer in the area of Ayia Paraskevi in Kato Lakatamia and that in the last 18 months 14 people died from cancer and 9 of those died from cancer of the bowel. An additional 10 people have been diagnosed and are suffering from other forms of cancer.

2. DEFINING A CANCER CLUSTER

The starting point of our study was to understand the scientific and epidemiological concepts behind cluster investigations. What is a cluster?

A cancer cluster is defined as an unusual number of cancers occurring during a specific time period among people who live or work together. It is not uncommon for people to suspect the that cancer cause is a chemical in the environment. Increased awareness about cancer and the search for a cancer cause has led to an increase in the number of *perceived* cancer clusters in many developed countries. However, on investigation, most clusters are shown not to be real but perceived clusters. The following cancer facts need to be understood in order to see a perceived cancer cluster in perspective.

2.1 Cancer is a common disease

Cancer is more common than most people realise. Cancer is the second leading cause of death in most industrial countries, following heart disease. About 30% of the population now living will eventually have cancer. Over the years, *cancer will strike about three out of four families*. Given these statistics, it is not surprising to know several people in an area or workplace who have cancer. The question is, is the number of cancers in Ayia Paraskevi more than expected?

2.2 Cancer is not one disease

Cancer is a group of more than 100 diseases characterized by uncontrolled growth and spread of abnormal cells. Different types of cancer have different causes, different rates of occurrence, and different chances for survival. What turns a breast cell into breast cancer isn't what turns a white blood cell into leukaemia. Therefore, we cannot assume all the different types of cancer in a community share a common cause. A real cluster is caused by an increase in the incidence of one cancer.

2.3 Cancer is age related

The risk of having cancer increases with age. While cancer occurs in people of all ages, cancer rates rise sharply among people over 45 years of age. When a community consists primarily of people over the age of 45, we would expect more cancers than in a more mixed area. We would expect even more cancers if most people were over the age of 60. Therefore, we would expect that Ayios Mammas, which has an old age structure, to have a particularly high rate of cancers.

2.4 Many causes of cancer

While the exact cause of most cancers is unknown, cancer may be caused by a variety of factors acting alone or together over many years. Scientists estimate that most cancers are associated with factors related to lifestyle, cigarette smoking, heavey drinking, lack of regular physical exercise, promiscuous sexual behavior, sunlight exposure etc. A family history of cancer increases a person's chances of developing some cancers. Environmental and occupational exposure to some chemicals and agents increases the risk of cancer as well. Nevertheless, the reaction of people to environmentally related cancer risk is the most prominent. This is due to the fact that their exposure to environmental pollution is beyond their will or control and it is provoked by other people’s activities. We do not know the exact impact of environmental pollutants on cancer development, but scientists estimate that fewer than 10%, *are related to external environmental factors such as radiation toxic chemicals etc*.

Cancers today are usually related to events that happened many years ago. Cancer does not develop immediately after contact with a carcinogen. Instead, there is often a long period, 15 to 30 years, between the exposure to a carcinogen and medical diagnosis of cancer. This makes it very difficult to track what caused the cancer. The cancers we see now are usually related to a lifetime of certain habits or exposure to a carcinogen many years ago. And, in a mobile society like ours, cancer victims who seem to be clustered may not all have lived in an area long enough for their cancers to be caused by exposure to a carcinogen in the community environment.

2.5 Clusters may be due to random variation

Cancer clusters may occur by chance. Even if there are more people with one type of cancer in a community than might be expected, we cannot assume it was caused by exposure to a cancer-causing agent in the environment. The cluster may have occurred

simply by chance. That is, an excess of one cancer in an area may simply be due to random variation.

There are several principles to keep in mind when investigating a cluster of cancer. People have a tendency to see patterns in random events. For example, in a coin toss, people assume that a sequence of 6 'heads' in a row is somehow less random than 'head-tail-head-head-tail-tail'. But in reality, both sequences are equally likely.

Another problem is that people tend to isolate a cluster from its context. This is known as the 'Texas sharpshooter fallacy'. The Texas sharpshooter shoots at the side of a barn and then draws a bull's-eye around the bullet holes. In the same way, we might notice a number of cancer cases, then draw our population base around the smallest area possible, neglecting to remember that the cancer cases actually came from a much larger population. To avoid this fallacy, it is safer to analyse rates by accepted census areas.

To decide whether the number of people with cancer in a reported cluster may be more than expected, scientists use data from national cancer registries to calculate an 'expected' number of cases. We can then compare the 'expected' number of cases with the 'observed' number by performing one or more statistical tests. In making statistical comparisons – usually at a '95% confidence level' – five of 100 comparisons may be significantly different by chance alone. This is because of the effect of random variation mentioned above.

Scientists have identified certain circumstances that may lead us to suspect a potential common source of cancer among people who are thought to be part of a cancer cluster. A suspected cancer cluster is more likely to be a true cluster, rather than a coincidence, if it involves:

1. A large number of cases of a specific type of cancer, rather than several different types;
2. A rare type of cancer, rather than common types; or
3. An increased number of cases of a certain type of cancer in an age group that is not usually affected by that type of cancer.

In Ayia Paraskevi there was a perception of a cluster of colorectal cancer. Over time, the perception has moved to include all cancers. This suggests that we are not dealing with a real cluster.

3. DEMOGRAPHIC CHARACTERISTICS OF THE INDEX AREA

Our examination of the social characteristics of the index area has showed that the age structure and social profile of Lakatamia municipality was similar to that of Lefkosia municipality. Within Lakatamia municipality, Ayios Mammas was different in that it had a very old age structure and a significant level of social deprivation, as measured by unemployment and educational attainment. The age and social profile of Ayia Paraskevi was similar to that of Lakatamia. It is widely recognised that cancer is strongly age related and also more common in deprived sections of the population.

We therefore expect that Ayios Mammas would have more cancers than the other areas in Lakatamia.

4. THE RESIDENTS PERCEPTION OF A CLUSTER

In our rapid appraisal exercise we spoke to a wide range of residents from across Lakatamia. The most important finding was that the perception of a cluster was confined to a relatively small section of the population that was clustered around the main road, and in the so-called 'triangle of death'. The majority of residents did not have concerns about cancer in their area, and a few people were sceptical about the idea of a cancer cluster in Lakatamia.

5. EPIDEMIOLOGY OF CANCER IN LAKATAMIA

We conducted a detailed epidemiological examination of cancer within Lakatamia, using all available sources of routine data, namely mortality, cancer registry and hospital activity data. It is important that this data analysis in interpreted in a way that takes account of the whole context of the study, as outlined above. We also need to understand some of the methodological problems of the analysis.

5.1 Data limitations

We must understand the limitations of the data. There are problems of data completeness and data coding. We must therefore exercise suitable caution in interpreting the data. Mortality is probably the most reliable source data in that it is reasonably complete, except for cause of death. Cancer registry data provides the most reliable geographic comparison of cancers. Hospitalisation data is a relatively poor measure of the incidence rate of cancer for it is strongly influenced by variations in clinical practice, variations in admission policies and variations in coding.

Despite limitations in the data sources, which is well described in section 5, we believe that the data is adequate to allow geographical comparisons to be made.

5.2 Selecting a standard for comparison

In order to see Lakatamia in the national context, we have used Cyprus as a whole as the standard for comparison. The other option was to use Lefkosia as a standard. Yet after considerable thought we decided to use the national standard. This means that in interpreting the results we must understand that the index area, which is largely urban and close to Lefkosia, is being compared with both urban and rural Cyprus. We would expect that urban Cyprus would have higher rates because of easy of access to medical services and because rural populations tend, on average, to be more healthy.

5.3 Mortality rates of Lakatamia

5.3.1 All cause mortality

The indirect age standardised ratio (ISR) for all cause mortality in Lakatamia municipality (ISR 74.1) was approximately 25% lower than both the Cyprus average (ISR 100) and Lefkosia district average (ISR 100.3) (Table 5.6, Figure 5.1).

Lakatamia also compares favourably against the other municipalities in and around Lefkosia City. Within Lakatamia municipality there was a four-fold variation in all cause mortality between the quarters. Mortality in Archangelos- Anthoupolis was approximately 65% lower than the Cyprus average (ISR=34.6), whilst mortality in Ayios Mammas (ISR 138.2) was 38% higher (ISR=138.2). Mortality in the index quarter of Ayia Paraskevi (ISR 88.9) was not unusual and was lower the Cyprus average.

5.3.2 Cancer mortality

Cancer mortality in Lefkosia district as a whole was observed to be approximately 30% higher than for Cyprus (ISR = 128.5). Rates were generally high in all of municipalities in and around Lefkosia with the exception of Geri, Anthoupolis Refugee Housing Estate and Lakatamia (Table 5.7, Figure 5.3). Indirect standardised ratios (ISR) show that cancer mortality in Lakatamia municipality was approximately 15% lower than the Cyprus average.

Within the quarters of Lakatamia municipality the pattern for cancer mortality is similar to that observed for all cause mortality. Rates in Archangelos- Anthoupolis were low and rates in Ayios Mammas were high. Rates in the index quarter of Ayia Paraskevi were low.

We conclude that the analysis of the mortality data does not provide evidence of an excess of cancer deaths in Lakatamia municipality in general, and the main index quarter of Ayia Paraskevi in particular. The second index quarter, Ayios Mammas, has high but 'in-control' all-cause and all cancer mortality rates, which are probably associated with its unusual socio-economic characteristics.

5.4 Cancer Registration

Cancer registration for Lakatamia municipality is approximately 19% higher than expected from the average Cyprus rates (ISR = 188.8, 95%CI: 105.7-133.0). However, while Lakatamia municipality cancer registration ratio is high compared to Cyprus, it is not unusually high when compared to the other municipalities in and around Lefkosia, falling approximately in the middle of the distribution. The overlapping confidence intervals suggest that the ratio is not statistically significantly different from that of any of the other municipalities listed.

Within Lakatamia, the highest overall level of cancer registrations is in Ayios Mammas (ISR=176.7 95%CI: 123.7-244.6). While it is statistically higher it is still within the control limits of the expected variation. Ayios Nicolaos, Archangelos-Anthoupolis and Ayia Paraskevi have ratios that are not statistically significantly different from those expected. There is no evidence of an overall excess of cancer registrations in Ayia Paraskevi.

The only specific cancer for which Lakatamia was outside of expected control limits was prostate cancer. This was due to high ratios in Archangelos-Anthoupolis (ISR

182), Ayios Mammas (ISR 197) and Ayios Nicolaos (ISR 349). The prostate cancer ratio in Ayia Paraskevi was not unusual.

We therefore conclude that the cancer registration data do not provide evidence of any unusual excess of cancer incidence that might be due to some special cause in Ayia Paraskevi. Ayios Mammas, consistent with its high mortality rate, also has a high incidence of most cancers.

5.5 Hospital admission rates

While Lakatamia has the highest cancer hospitalisation rate (with the exception of Geri) of all the comparator municipalities (ISR=128, 95%CI: 117.4-140.3), the rate is not dissimilar to that seen in Lefkosia and Latsia municipalities (Figure 5.22). Our analysis highlighted prostate cancer, and cancer of the urinary tract, as having potentially extreme levels in Lakatamia.

Prostate Cancer

The high level of hospitalisation for prostate cancer is consistent with that seen for prostate cancer registration. It should be remembered that for cancer registrations Ayios Mammas and Ayios Nicolaos had high levels, not Ayia Paraskevi.

Urinary tract cancers

The high level of hospitalisation for cancers of the urinary tract is *not consistent* with the unremarkable level of registrations for these cancers within Lakatamia. Of the two data sources the cancer registrations are considered to be a better proxy for the incidence of cancer than are the hospital inpatient records, for reasons discussed in section 5, under the heading Limitations of the data.

The most common urinary tract cancer is bladder cancer, a disease that requires frequent repeat follow-up cystoscopies. This means that patients with bladder cancer are likely to require a number of hospital admissions. Variations in clinic practice, and variations in the frequency with which bladder cancers are followed up are likely to have a significant impact on hospital admission rates and this probably accounts for the high level found in Lakatamia.

6. ENVIRONMENTAL FACTORS

The environmental measures of electromagnetic fields and breast milk were well within normal limits. There is no evidence to suggest that any other environmental factor is causing cancer in the area. A review of the health effects of asbestos water pipes shows no evidence of a link to cancer.

7. CONCLUSIONS

1. We conclude that there is no evidence of an excess of cancers within Ayia Paraskevi. In particular, there is no evidence of an epidemic of bowel cancer in the index area. It is now important for these conclusions to be carefully discussed with local residents. A successful outcome to this study is not only to show that

there is no excess of cancer, but also to convince the local population of this fact. This medical research study has provided convincing medical evidence to persuade even the most mistrustful people.

2. We conclude that there is an excess of cancers in the area of Ayios Mammas, which is most probably related to the socio-economic profile of the area. There is no evidence that the excess cancers are due to environmental factors. Attention should be directed to improving the health status of the area.

7. RECOMMENDATIONS

1. The findings of this complex study should be carefully communicated to politicians, important opinion formers, the press and the local population.

2. There should be a programme to improve the health and socio-economic status of residents within Ayios Mammas.

3. Attention should be given to improving still further the routine sources of data that are the lifeblood of epidemiological research.

Terms of reference for the study

1. The medical study must commence within 10 (ten) days form the date of the signing of the contract and must be completed within 12 (twelve) months from the date of the signing of the contract.

2. The Consultants must prepare within a period of 20 (twenty) days from the date of the signing of the contract a detailed protocol for the research study, which must describe (amongst other issues) the ability to overcome any obstacles, set out a prototype describing the way of collecting and evaluating data. The ability of the members of the team must be transparent as described in paragraph 2.12.3 (e) of the documentation supplied. It must also show how the study will be coordinated and meet the conditions of the terms of reference of the medical research.

3. The team of Consultants must have the capability of collaboration with recognised academic institutions from overseas that have links either directly or indirectly on the subject of this research study.

4. The team of consultants is required to collaborate with the Ministry of Health's representative during the period of the project on the following:

   4.1 To undertake a local survey (including electronic form) of all the incidents of cancers and leukaemia for the geographic area of Kato Lakatamia for the period from 1994 to 2003. The cancer episodes must be recorded and drawn on the attached map with the following details:

   a) The date on which cancer or leukaemia was diagnosed.
   b) The home address of the person who has been diagnosed.
   c) The type of cancer or leukaemia
   d) Whether the person is dead of alive.

   4.2 The consultants must carry out a local census and develop a questionnaire to collect information on health status, death certificates, medical history, results of biopsy etc. The sources of data collection would include, hospitals, cancer registry, oncology departments or centres, clinics, priests, government departments, semi-public organisations, municipalities, patients and relatives of people who died. In some cases in might be necessary to carry out census of cemeteries in order to cross reference the information on deaths.

   4.3 All episodes of cancer or leukaemia must be substantiated from the results of biopsies or other analytical determinant for each specific episode. A copy of each record substantiating each episode must be matched to the information gathered from the questionnaire.

   4.4 The collection of the above data must be carious out with the consent of the individual patients who wish to confirm the specific diagnosis of their condition. For the cases of death from cancer or leukaemia the relevant data must be obtained with the consent of the next of kin.

4.5 Assessment of Standardised Mortality Ratios (SMR) and Age Specific Mortality Rates. For this purpose data must be collected on the basis of para 4.1, 4.2, 4.3 and 4.4 above and compared with data collected from other areas in Cyprus, which would be used as controlled groups.

4.6 Design and distribution of a medical and social questionnaire for the residents of Kato Lakatamia. The questionnaire must be designed in such a way for the collection of essential data for the possible connection to environmental and other factors that might possibly contribute to the anxiety of the residents of the local area in relation to the episodes of cancer. The distribution and completion of the questionnaire would be carried out using a stratified random sample using the area of Ayias Paraskevis of Kato Lakatamia as a geographical focal centre. The population of the area according to the 2001 Census was 11754. Data should also be collected for a possible pollution of the area from any activities that might have happened in the past. Amongst other things there should be an examination of area photographs and other available materials.

4.7 Tracking down and measurements of electromagnetic fields. For this purpose there must be a selection of a number of estates (at least 20 houses) where there had been incidents of cancer or leukaemia in which there must be measurements of electromagnetic fields. In parallel the team of consultants must investigate maps and topographical designs of the area for tracking down origins of electromagnetic radiation. Origins of electromagnetic radiation should be considered within the houses of patients who had incidents of cancer or leukaemia as well as outside. In appendix 6 there are basic guidelines, which the team of consultants should take into account in the preparation of the protocol for the measurements of the electromagnetic radiation.

4.8 Analysis of Polychlorinated Biphenyls (PCBs), Dioxins (Polychlorinated Dibenzofurans, (PCDFs) in sampling of human milk.

The samples must be taken from breast feeling mothers in the area according to the guidelines of Appendix 7.

5 The Proposer must provide a detailed statement for the Laboratories he proposes to cooperate with for the analysis of the samples as described in para 4.7 above as well as the requirements for the temporary maintenance and storage of the samples until they reach their final destination.

6 The Ministry of Health will provide the Consultants with an office of 10 square meters space in Room 103, Markou Drakou Street, for storage of office materials and facilities for meetings between the Consultants and the representative of the Ministry of Health, for the evaluation of data and on going progress monitoring of the study. This office will be used for safe keeping of all documents, questionnaires, results of sample analysis and electromagnetic field measurements, results of medical examinations and para-clinical examinations, and any other specific materials, which would the property of the Cyprus Government.

7 The team of Consultants will work closely and cooperate with Dr Andreas Georgiou, Chief Medical Officer, with specialties in Community Medicine and Hygiene, Occupational Medicine, and General (Practice) Medicine, who will be the representative of the Ministry of Health. It is hereby clarified that in case of conflicting opinions, the opinion of the representative of the Ministry of Health will override as regards the level, extent and quality of services provided by the Proposer as defined in paragraphs 4.1, 4.2, 4.3,4.4 4.5,4.6 and 4.7, as well as Appendices 6 and 7.

8 It is hereby clarified that before any payment is made to the Proposer and/or the Consultants the written approval of the representative of the Ministry of Health is required.

9 The Proposer must submit the final report (with an executive summary) to the Minister of Health and the Permanent Secretary of the Ministry of Health, which must be accepted.