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Magnetic fields and cancer in people residing near Swedish high voltage power lines

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MAGNETIC FIELDS AND CANCER IN PEOPLE RESIDING NEAR SWEDISH HIGH VOLTAGE POWER LINES

PREFACE

We want to acknowledge the contribution of a large number of people to this study. During the planning of the study a reference group was formed. The group met twice during the planning and the initial phases. After that we have consulted individually with several members of the group. The reference group consisted of John A. Bonnell, Kjell Hansson Mild, Bengt Knave, Jaak Nou, David A. Savitz, and Peter Westerholm.

When this study was initiated, there was already a group working with problems related to magnetic field measurements in homes. The spot measurement protocol and the specifications for the instrument were developed in collaboration with this group. The group consisted of Arne Eriksson, Kjell Hansson Mild, Uno Jonsson, Thomas Lindh, Lars Erik Paulsson, Mats Waltre, and Ulf Östman.

Mats Waltre was affiliated with the project during an extended period of time, mainly providing guidance for the magnetic field calculations.

Thomas Lindh has assisted with calibrations of the instruments on a regular basis for the duration of the project.

Lars Prabin has serviced and improved the instruments at several times.

The planning of the 24 hour measurements was done in collaboration with Birgitta Floderus, Bengt Knave, and Thomas Lindh.

Rolf Lindgren coordinated all the measurement work as well as the work required to obtain historical loads.

Sven Svensson provided information on historical loads on the relevant power lines.

The measurement field work and preparation for the measurements and calculations were performed by personnel at the various power line companies. We want to mention especially Jan Widström, Henry Söderman, and Sven Ström.

The work at the parish offices were performed mainly by local personnel. The work at the local tax authority in Stockholm was carried out by personnel employed by the project but with assistance from the local tax authority personnel.

The Central Board for Real Estate Data, the National Board for Health and Welfare, and Statistics, Sweden provided information from their respective data basis. So did the Health Protection Boards of the towns crossed by the power lines.

Elisabeth Lindgren and Helena Wennborg have read the medical records and verified the diagnoses.

Mette Lindevall, Gun Johnson, and Bahman Vektye have been providing different sorts of computer assistance.

Gunilla Bergström, Karin Söderman, and Gun Wiklander have been working with different parts of the study for the duration of the project.

Lars Alfredsson, Kjell Hansson Mild, Bengt Knave, Göran Pershagen, and David A. Savitz have all read a previous version of this report.

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SUMMARY

The aim of the present study was to test the hypothesis that exposure to magnetic fields of the type generated by high voltage power lines increases cancer incidence. The study was designed as a case-control study, based on the population comprised of everyone who have lived on a property located within 300 meters from any of the 220 and 400 kV power lines in Sweden during the period from 1960 through 1985. For adults it was required that the duration of residence was at least one year. The corridor was chosen to be wide enough to ensure that it included both exposed and unexposed homes. The cases were all instances of cancer diagnosed between 1960-85. For children, all types of cancer were included, while for adults the study was restricted to leukemia and brain tumours. The cases were identified through a record linkage to the Cancer Registry. The controls were matched to the cases on time of diagnosis, age, sex, parish, and power line. Exposure was assessed in several different ways. First, spot measurements were performed in the homes of the subjects. Second, the magnetic fields generated by the power lines were calculated by means of a computer program taking distance, line configuration, and load into account. At the same time as a spot measurement was performed, the load on the line was obtained and the magnetic field calculated. Historical loads were obtained from records that were kept by the station managers. By using these in the program, calculated historical fields were obtained for various time periods appropriate from the etiological point of view. These calculated historical fields were the main source for classifying study subjects into different levels of magnetic field exposure. Thus, the main exposure metric was the annual average of the calculated magnetic field generated by the line. Third, for a sample of the subjects, 24 hour measurements were also performed.

For childhood leukemia and with cut off points at 0.1 and 0.2 μT , the relative risk (RR) increased over the two exposure levels and was estimated at 2.7 (95% c.i.: 1.0-6.3) for 0.2 μT and over. The test for trend gave a p-value of 0.02. When the upper cut off point was shifted to 0.3 μT the RR was instead 3.8 (1.4-9.3) and the corresponding trend test gave a p-value of 0.005. These results persisted when data were broken down by gender, age, time of diagnosis, and area of living. However, it appeared that the relationship was confined to one family homes. There was some relationship with distance but no relationship with spot measurements. Control for confounding from air pollution or socioeconomic status did not change the results. For brain tumors or for all childhood cancers together there was little support for an association.

In adults and for magnetic fields of 0.2 μT and over, the RR for acute myeloid (AML) and chronic

myeloid leukemia (CML) were estimated at 1.7 (0.8-3.5) and 1.7 (0.7-3.8), respectively. This result persisted in most analyses. For brain tumours no association was seen.

The finding of an association, in childhood leukemia, with calculated historical fields but not with measurements are consistent with the assumption that historical calculated fields are reasonably good predictors of past fields but that spot measurements are poor predictors of those fields. The confinement of an association to one family homes might be explained by a limited accuracy in exposure assessments in apartment houses. The results provide support for the hypothesis that exposure to magnetic fields increase the risk of cancer. This is most evident in childhood leukemia. What aspect of the fields that might be involved remains unclear.

INTRODUCTION

In 1979 Wertheimer and Leeper reported an excess in cancer mortality in children living in homes with presumed elevated magnetic fields (Wertheimer and Leeper 1979). Three years later Milham reported that people in occupations potentially associated with magnetic field exposure might have an increased leukemia risk (Milham 1982). These two reports formed the basis for the hypothesis that exposure to weak, extremely low frequency electromagnetic fields might be of importance in the origin of cancer. During the eighties and early nineties, the original reports have been followed by further epidemiologic research on people with residential as well as occupational exposure trying to confirm the findings and to learn more about the possible relationship (Ahlbom, 1988; Savitz and Ahlbom, in press). Extensive experimental research investigating the interaction between biological systems and magnetic fields has also been conducted (See for instance the proceedings from The First World Congress for Electricity and Magnetism in Biology and Medicine, Florida, June 14-19, 1992).

The present study was designed in a somewhat different way as compared to previous studies on residential magnetic field exposure and cancer. The design took advantage of the population registry system in Sweden thereby minimizing the potential for selection bias, a concern in previous studies. Furthermore, by defining the study base as people who have lived in a corridor around high voltage power lines, transmission lines were the dominant source of exposure, thereby providing for a novel approach to exposure assessment. This also facilitated the control for factors associated with area of residence. The aim of the present study was to test the hypothesis that exposure to magnetic fields of the type generated by high voltage power lines increases cancer incidence. In particular, the study investigated leukemia and brain tumors, as well as other cancers in children.

MATERIALS AND METHODS

Overview of study design

The study base consisted of everyone who had lived at least one year on a real estate at least partly located within 300 meters from any of the 220 and 400 kV power lines in Sweden during the period from 1960 through 1985. For children, the one year limit was not applied, but all children were included regardless of the duration of their residence within the corridor. The corridor was chosen to be wide enough to ensure that it included both exposed and unexposed subjects. Since the number of people included in the study base was large, close to half a million, it was impossible to assess

exposure for everyone. Thus, a nested case-control study was conducted within the study base.

The cases were all instances of cancer diagnosed within the study base. For children, all types of cancer were included, while for adults the study was restricted to leukemia and brain tumours. The cases were identified through a record linkage to the Swedish Cancer Registry. The controls were selected randomly from the study base with matching to the cases on time period of diagnosis, age, sex, parish, and power line.

Exposure was assessed in several different ways. First, spot measurements were performed in the homes of the subjects according to a specified protocol and using a meter constructed for this study. Second, the EMF generated by the power line was calculated by means of a computer program taking distance, line configuration, and load into account. At the same time as the spot measurements were performed, the load on the line was obtained from the station and the magnetic field calculated. This allowed for a comparison between the measured field and the calculated, and thus, for an evaluation of the validity of the calculations. Historical loads were obtained from records that were kept by the station managers. By using these in the program, calculated historical fields were obtained for time periods prior to the diagnoses and appropriate from the etiological point of view. These calculated historical fields were the main source for classifying study subjects into different levels of magnetic field exposure.

Potential confounding from time period, age, sex, geographical area, socioeconomic status, and road traffic was evaluated with stratification and multivariate statistical techniques.

Data were analyzed by estimating the relative risk (RR) comparing the cancer incidence across levels of magnetic field exposure. The random variability of the RRs was determined by 95% confidence limits.

Study base

In 1987, Sweden had about 15 000 kilometres of 220 and 400 Kv power lines distributed over the entire country. They run over long distances in sparsely populated areas particularly in the northern parts of the country. They also run through towns, but the only bigger city that has this type of power line is Stockholm. The total length of the lines that run in Stockholm is short, but since Stockholm is densely populated, a large proportion of the people who live near high voltage power

lines live in Stockholm. The 220 and 400 kV lines are owned by a few different companies.

In order to establish the study base, each of the involved owners provided maps over the areas where their respective lines were located. These maps were presented to The Central Board for Real Estate Data which maintains a computerized data base with coordinates for all real estates in Sweden. The Central Board for Real Estate Data identified all properties located, totally or partly, within a corridor of 325 meters on each side of the lines and provided a list of them. The reason for choosing 325 meters rather than 300 as the boundary was a test run on one line, which indicated that the actual resolution of the digitized maps was such that it would lead to a loss of some properties if the 300 meter distance was used. Furthermore, a small number of properties, such as farms, were large and the location of the land provided little information about the location of the buildings. Indeed, some buildings could be more than a kilometre away from the line. Thus, a limit was employed such that only buildings within 800 meters were included.

The population registry was used as the source of information to identify the individuals who had been living on the listed properties. In principle, each residence was looked up in the registry and information on everyone who had been living there was extracted. The extracted information was personal registration number, name for those with incomplete or missing personal registration number, and period of living on that property. For children up to the age of 16, everyone was included, but for those over 16 it was required that they had lived at least one year on a property within the corridor. The population registry is decentralized and run by the various parish offices except in the city of Stockholm where a registry with information from all Stockholm parishes is operated by the local tax authority. The population registry was organized in different ways in different places and more or less well suited for the purposes of this investigation. The system that was used in Stockholm required that annual computer printouts had to be checked for each property. This made the procedure extremely time consuming. The work space in the archive where the Stockholm data were stored and the way the material was organized prohibited the employment of more than two or three people simultaneously for this task. Thus, the work could not be speeded up by the enrollment of more personnel. Eventually, two out of the 21 power lines in Stockholm had to be excluded for this reason. In most parishes outside Stockholm, a system with one registry card for each household head, sorted by residence was used. As soon as a person moved in to the real estate, or was born there, a note was made on the card and when a person moved or died this was also noted on the card. This system was well suited for the purposes of this study. A small number of parishes

had their registries organized in such a way that the residences could not be looked up, but only individuals. These had to be excluded from the study. They were Norrsunda, Sundbyberg, and Gunnarsnäs. The same applied to Köping before 1969. Söndsjö in Bräcke refused us access to required information. Except for Sundbyberg, the effect of excluding these parishes was negligible. All the information that was extracted from the parish registries was entered into a computer.

The people were followed up from 1960 or from the time they were born or moved into a property within the corridor. They were all followed through 1985, whether or not they were still living within the power line corridor at that time. The year 1985 was chosen, since it was the most recent year to which the Cancer Registry was updated at the time of the first matching.

Cases and controls

The diagnostic groups that were used were all cancers for subjects up to 16 years and leukemia and cancer of the central nervous system (CNS) for those older than 16. Separate analyses were done for acute and chronic lymphatic leukemia (ALL and CLL) and for acute and chronic myeloid leukemia (AML and CML). For CNS cancer, the major types of malignant tumour, astrocytoma I and II (glioma) and astrocytoma III and IV (glioblastoma) were included. The diagnostic codes were those used by the Swedish Cancer Registry, that is International Classification of Diseases (ICD) 7. For leukaemia, the Cancer Registry changed the classification system during the study period and from 1975 leukemia was classified according to ICD 8. All codes were not immediately transferable and, thus, a special scheme for this was developed by the Cancer Registry. The leukemia codes for the present study, according to ICD 8 were: 204, 205, 206, and 207. For CNS cancer, the ICD code must be combined with the pathologic anatomic diagnosis (PAD) code in order to separate the relevant types of cancer. Thus, the codes used were: ICD7 193 and PAD 475 and 476, respectively.

Cases of cancer were identified by a record linkage to the files of the Cancer Registry operated by the National Bureau of Health and Welfare. The ten digit personal identification number, which is used in all official registries in Sweden, was used for identification. Some individuals had an incomplete personal identification number such that the last 4 digits were missing. For these individuals, a record linkage was performed on the remaining six digits and the name was used to check those individuals that matched. Finally, for children, a record linkage was performed to the Mortality Registry operated by Statistics, Sweden to determine whether there were any cases of cancer mortality, which were not registered in the Cancer Registry. Two additional childhood cancer

cases were found this way. For all identified cases it was determined that the individual had lived in the power line corridor before the diagnosis and for adults that they had lived in the corridor during at least one year before the date of diagnosis.

For all childhood cancer cases identified according to the procedure described above, the medical records from the hospital where the cancer was treated were sought in order to verify the cancer diagnosis. All medical records but two were found. For those with medical records, the cancer diagnosis could be verified in all but two and these two were thus excluded. For the adults, the diagnoses recorded in the cancer registry were accepted.

The controls were selected at random from the individuals in the study base. For the children, four controls were selected per case and for the adults, two. For each case, the controls were selected among those who were included in the study base during the year of diagnosis of the case and who were of the same one year age group for children and five year age group for adults, the same sex, lived in the same parish, and lived near the same power line as the case. In some parishes there was not a sufficient number of individuals fulfilling all these matching criteria. In those instances, an eligible control was sought in the adjacent age group. If a control still could not be found, the area was increased to include also other parishes within the same town. If this did not suffice either, the sex criteria was relaxed. If a control still could not be found despite these adjustments in the matching criteria, the already located number of controls for that case was accepted. Thus, some cases have less than the stipulated number of four or two controls, respectively.

Magnetic field assessment

Magnetic field exposure was assessed in several different ways. First, spot measurements were performed in the homes where the cases and controls lived at the time of diagnosis of the case. If the case had moved out of the corridor before diagnosis, measurements were made in the last home occupied by the case within the corridor and the corresponding control home. These measurements were performed with an instrument designed for the purpose of this study and built by Sydkraft (3-dimensional magnetic flux density meter for 50/60 Hz, Sydkraft. Instrument and Electronics). The instrument used three perpendicular coils and a 50 Hz filter. The resulting field was calculated as the square root of the sum of the three squared components. The antenna was mounted on a one meter tripod. The sampling time was 10 seconds. All measurements were loaded in a laptop PC. The meter

was constructed so that the measurement results could not be displayed during the measurement period but only after the diskette with the data had been returned to the study coordinators. Nor were there any controls on the meter or the computer that could be used for anything but starting and stopping the instrument and entering information requested on the display menu, such as address, type of room, etc. The instruments were calibrated regularly. Occasionally, it was determined that an instrument had been malfunctioning during a period of measurements and as a consequence these measurements were repeated.

A measurement protocol was developed following the procedures used by Savitz et al. (1988). Four five minute measurement periods were used in each home. On entering the house, the room in between the rooms closest to the line and furthest away from the line was identified - the central room. The first measurement period was in the central room with all appliances left on that were on when entering the home - high power measurements. Then, the main current was turned off and measurements were taken in three different rooms located perpendicular to the line - low power measurements. One room was taken as close as possible to the line, one as far away as possible, and the third was again the central room. In homes with only two rooms, measurements were taken twice in one room. The computer guided the technicians in choosing the rooms for measurements.

For people living in apartment houses, the obtained information did not specify in which apartment the subject lived. To get this information the owner of each apartment house was contacted and requested to provide information about the specific apartment and name and phone number of the present inhabitant. However, for some apartment houses the owner did not agree to cooperate or had not kept the appropriate records. In these instances measurements were performed in the hallway rather than in the appropriate apartment. This was done for 200 out of the 626 apartments in which measurements were performed.

The power companies produced the information that was required for the measurements and the calculations. This information included a detailed map of the area and specifications about the line and the towers. This information was prepared from lists of homes with no information on case/control status.

The measurements were carried out by technicians employed by the different power line companies. They were not informed whether they were visiting a case or a control home, but may have found out

that during the visit. They were instructed to avoid any discussions about the possibility of an association between magnetic fields and health risks.

No measurements were performed in homes that had ceased to exist. If the power line was not in use any more, or out of use for an extended period of time, measurements were done anyway, in an attempt to assess the fields from internal sources. If the line was temporarily de-energized, measurements were rescheduled to a time when the line was back in operation.

The measurement field work turned out to overextend the power line companies and it was determined, when all other necessary information was collected, that the number of performed measurements was sufficient. For children, measurements were performed in 62% of the homes and for adults in 54%. Most unmeasured homes were inside Stockholm.

For the purpose of the analyses in this report, each home has been characterized by the mean value of the low power measurements across all rooms.

Second, the magnetic field generated by the line was calculated. These calculations were performed with a computer program developed within The State Power Board (The program is now available through Vattenfall Utveckling AB). The program calculated each component separately and the resultant was taken as the root mean square of the components. The calculations took account of height of towers, distance between towers, distance between phases, ordering of phases, and load on the line. It could also take account of other nearby lines. Furthermore, the location of the house in the span between the towers was accounted for as well as the altitude of the home in relation to the altitude of the line. Finally, the distance between the house and the line was taken into account. The distance was taken between the part of the home that was closest to the line and the mid point between the outer phases.

For each home, a large scale map was used for measuring the proximity to the line. At the visit to the home, when the measurements were performed, it was also checked where in the span the home was located, and the presence of other lines near the home was noted at the same time. The distance measured on the map was also verified during the visit.

During the visit to the home, the station responsible for operation of the line was phoned and

information about the load on the line and direction of the current during the measurement period was obtained. This load was used as input when assessing calculated contemporary fields.

Since the cases in this study were diagnosed over a 26 year period, it could not be assumed that the load on the line near the home was the same during the etiologically relevant period as it was at the time of the phone call to the station. Thus, the annual average of the load on each line was obtained for every year during the period 1958-85. Furthermore, even earlier information was obtained for those cases and controls where it was necessary, that is for cases diagnosed early during the study period and the corresponding controls. The earliest year used for the study was 1947. It was possible to obtain this information on historical loads, since detailed records from the operation of the different lines were kept and saved (Sven Svensson, personal communication). These records had information about the operation of the line, including the load, for each hour of the day for all days over the year. This information was summarized to annual averages. For a small number of lines, there were periods for which this information could not be located. However, these lines were located in the system in such a way that reasonable estimates could be made based on the information about neighbouring lines in the system. For distribution lines in the neighbourhood of the homes no historical records were available. Thus, for these lines the load was assumed to have changed over time at the same rate as the high voltage line. The historical loads were used to calculate historical fields. This was done for each case and corresponding controls at the year of diagnosis, one, five, and ten years before diagnosis, and for children at the time of birth and at the time of conception.

Third, for a sample of the subjects in the study, 24 hour measurements were obtained with a personal dosimeter. The sample included one child and one adult from the same family and consisted of close to 100 subjects. The dosimeter used for this study was the Positron (The Electromagnetic Dosimeter. Product # 50 Hz 378102 & 60 Hz 378101. System Manual. Positron, 1991). This is of pocket size and can be carried in a case and worn on a belt. The Positrons were set to sample and record the magnetic field at 5 second intervals. The meters were left with the family at the visit when the measurements were performed and they were picked up 24 hours later. A simple questionnaire was administered along with the meter. The questionnaire asked for time when leaving and entering the home, time spent in the garden, at school, and at work.

Magnetic field assessment validation

The various exposure assessments were validated by a number of different comparisons. First, the

calculated contemporary fields were compared with the measured fields. The purpose of this comparison was to evaluate the precision by which the calculations could predict the actual measured fields. If the power line were the only magnetic field source in the home and on the assumption that the model and the data it uses are correct, the calculated field would agree with the measured.

Second, the measured fields were compared to the historical calculated fields. The purpose of this comparison was to demonstrate what would happen if fields assessed under contemporary conditions were used as estimates of historical fields dating back as long as in this particular study.

Third, the distance from the home to the line and the measured field were compared in order to demonstrate to what extent distance predicts magnetic fields.

Since the subjects do not spend all their time at home an attempt was made to estimate the contribution of inhome fields to the total exposure. Thus, the averages of the 24 hour measurements were calculated for each person included in the 24 hour measurement sample. The average of the low power spot measurements were compared to these averages. In addition, an average of the dosimeter measurements for those hours spent at home was also calculated for each subject in order to take into account the contributions from appliances and other sources in the home. The averages of the spot measurements were compared also to these averages.

Exposure definition

Several different ways to define exposure for the subjects in the study were employed. Most emphasis was placed on the calculated historical fields. They were preferred over the spot measurements because of the difficulty in using contemporary measurements to estimate historical exposures, for some subjects several decades back in time. Thus, for each subject, the calculated historical field was determined based on the average load for the relevant year. For each subject, several different years prior to diagnosis of the case were used. Different cut off points were used to make sure that the results were not sensitive to the choice of cut off points. The points chosen were 0.10, 0.15, 0.20, 0.25, and $0.30\mu\text{T}$. It was not considered meaningful to use higher cut off points, since the number of subjects in the exposed category would be too small for meaningful analyses. Most emphasis was placed on the three level scale: < 0.09 , $0.10 - 0.19$, $0.20 - \mu\text{T}$; that is, the majority of the presented analyses use this set of cut off points.

Also results based on the spot measurements are presented. The cut off points chosen for these analyses were those described above.

Finally, some analyses based on proximity to the line are given as well.

Confounders and effect modifiers

The data were stratified according to age, sex, and year of diagnosis. Stratification was also done for whether or not the subject lived in the county of Stockholm and whether the home was a one family home or an apartment house home.

The data were matched to several censuses performed by Statistics, Sweden. All of these censuses, except the 1965 and 1975 census, included a socio economic index. For each subject in the study, this information was taken from the census closest in time before diagnosis for the case except when this census was 1965 or 1975. In these instances, the census with the socioeconomic index closest in time to diagnosis was taken. For children, the census closest in time after birth or diagnosis was used. However, for about 15% of the children a socioeconomic index could not be found and these subjects had to be excluded from the analyses that required this type of information.

Air pollution from traffic was estimated according to a method described by the Swedish Environmental Protection Board (Naturvårdsverket. Meddelande 8/1984). This method uses the NO₂ content in the air as an index of air pollution from road traffic. The method estimates the out door air and gives the 99th percentile for one hour averages over one year. The method is based on background level, distance, traffic flow and width of the street. The input data were obtained from the public health authorities in the different towns for the relevant years. In the analyses the data were stratified in below and above 50 μg per m³, which gives about 25% of the subjects in the upper category.

Statistical methods

Association between exposure and disease was measured by the incidence rate ratio, in the text referred to as the relative risk (RR). This was estimated according to standard epidemiologic methods for case-control studies with incidence density sampling of controls. The random variability was assessed by 95% confidence limits. The exact method was used when the cell with the smallest number of subjects contained less than ten subjects. Stratified analyses were performed with the

logistic regression model. In a few instances, the iterations did not converge, in which case the Mantel-Haenszel procedure was employed. The matched analyses were done with conditional logistic regression. Tests for trend were done according to the Mantel extension technique. See further Breslow and Day (1980) and Rothman (1986).

RESULTS

Study base

Table 1 gives some details about the people included in the study base. Altogether, they were close to half a million people. The age and time period data refer to the situation when entering the study base. The total number of addresses was 534 675. People had moved up to 11 times. People within Stockholm county tended to move within the county and people in the rest of the country tended to move within those parts of Sweden. Moving was more common within Stockholm.

Cases and controls

The number of subjects in the study are described in various ways in Tables 2.1-2.5. The total number of cases in children is 142 and the corresponding number of controls is 558. Thus, the number of controls is somewhat less than four per case. For one case and four controls, no exposure assessments were possible. The table with diagnostic categories shows that the majority of the leukemia cases are acute lymphatic leukemia and that the largest diagnostic category after leukemia and brain tumours is lymphoma.

There are 548 adult cases, 325 leukaemias and 223 brain tumours. The total number of adult controls is 1091. In two cases and eight controls, no exposure assessment was possible. The majority of the leukaemia cases fall into one of the four types AML, CML, ALL, and CLL but there are 50 cases distributed over other leukemia types. For brain tumours, only the types considered in this study were selected. About 70% belong to the more malignant type astrocytoma III-IV or glioblastoma, the rest being astrocytoma I-II or glioma.

Table 2.5 shows duration of residence within the corridor for the subjects in the study, that is the length of time for which exposure may be estimated based on the collected information.

Magnetic fields

Tables 3.1-3.5 describe the distributions according to the various exposure metrics used in this study.

Table 3.1 gives the average of the low power measurements and the calculated contemporary fields by time of year. The exposure levels are somewhat higher during the winter season, most clearly reflected in the category 0.1-0.19 μT . Tables 3.2 and 3.3 give the magnetic field distributions for one family homes and apartment houses. These tables show two things. First, there is a trend towards higher magnetic fields for the contemporary calculations as compared to the historic. Second, for the spot measurements, but not for the calculated fields, the fields are higher in the apartment houses than in the one family homes. Tables 3.4 and 3.5 give the distributions for Stockholm and Sweden, Stockholm excluded. Both measurements and contemporary calculations indicate higher fields in Stockholm than outside, but this difference does not exist in the historical calculations.

Figure 3.1 gives a plot of the calculated contemporary fields and the average of the low power measurements. Generally, the correlation is good. Figure 3.2 shows a similar plot but based on calculated historic fields and now the correlation is not so good. However, for the purpose of this study the interest is focused to the lower left hand corner. Thus, Table 3.6 gives a cross tabulation of the calculated and the measured fields dividing the levels into the three categories: - 0.09, 0.1-0.19, and 0.2- μT . These are the cut off points used for most of the analyses presented later in this report. Twenty percent of the observations are off the diagonal. Most of these are values calculated to belong in the lowest category but for which measurements give values in the intermediate or high category. Table 3.7 gives the corresponding information but based on calculated historical fields. The results are similar but in this table 30% of the observations are off the diagonal. Again, the vast majority are caused by the spot measured fields being higher than the calculated. Tables 3.8-3.11 show the same comparisons separately for one family houses and apartment houses. It is clear that the agreement between measurements and calculations is better for one family houses. In particular, the agreement between spot measurements and calculated historical fields in apartment houses is poor.

Figures 3.3 and 3.4 show the correlation between proximity to the line and spot measurements and historic calculated fields, respectively. Both graphs show the calculated field falling off roughly as the inverse of the distance. Figure 3.5 and 3.6, finally show the comparison between the 24 hour measurements and the spot measurements.

Magnetic fields and cancer in children

The results from the analyses on magnetic fields and cancer in children are displayed in Tables 4.1 and the following. Quite a few tables are presented in order to provide as much information as possible about the primary data. The data are analyzed in a number of different ways in order to show the extent to which the results are internally consistent and in an attempt to identify subsets of the study subjects for which the results might be particularly informative. It is evident that several of the tables contain little information due to small numbers, but also this was considered worthwhile to report.

First, the calculated historical fields were used as the basis for exposure assessment. Table 4.1 shows the relative risk for calculated historical fields closest in time to diagnosis. That is, for those who still lived in the corridor at the time of diagnosis, the year of diagnosis was used for calculation of the magnetic field and for those who moved out of the corridor before diagnosis, the last year in the corridor was used. Relative risks were calculated for the exposure categories 0.1 - 0.19 and 0.2 - with - 0.09 as the reference category. Results are reported for all cancers together and for leukemia and brain tumour separated. The table shows a relative risk for leukemia that increases over the two exposure levels and that is estimated at 2.7 (95% c.i.: 1.0-6.3) for 0.2 μ T or higher. The test for trend gave a p - value of 0.02. For all cancers together or for brain tumours, there is no increased risk. Tables 4.2 - 4.5 show the results from the same analyses but with different cut off points. As can be seen from the tables, the results do not change much, but the relative risks for the highest exposure category tends to increase as the cut off point is shifted upwards. For 0.3 μ T or higher, the relative risk is estimated at 3.8 (1.4-9.3). The corresponding trend test p was 0.005.

Tables 4.6 - 4.8 give the results when the calculated fields are based on the situation one, five, or ten years before diagnosis. The results are difficult to interpret because of small numbers, especially for the results ten years prior to diagnosis. However, the results remain virtually the same as before with an elevated relative risk for leukemia but not for total cancer or brain tumour.

Tables 4.9 - 4.12 are restricted to subjects who lived in the corridor at certain points in time or time periods in relation to the time of diagnosis of the cases. Table 4.9 is similar to Table 4.1, but the analysis is restricted to those who lived in the corridor at the time of diagnosis. The numbers in Table 4.9 are smaller but the estimated relative risks similar. Tables 4.10 and 4.11 are both based on children who lived in the power line corridor at birth. In these tables the leukemia excess risk

disappears, but based on only one child in each of the two exposed categories rendering the results uninterpretable.

Tables 4.13 and 4.14 display the results by gender showing that the results are similar in boys and girls, with a relative risk for leukemia that is around two and that is higher in the highest exposure category. In Tables 4.15 - 4.17 the findings are instead presented by age at diagnosis in five year age classes. Even though numbers get small, the results are in essence the same as before. Tables 4.18 and 4.19 show the results divided by area of living. Table 4.18 shows the results for residents in Stockholm county and Table 4.19 for residents outside Stockholm county. Again, the findings are similar as before despite small numbers in some categories. In Tables 4.20 and 4.21, the results are broken down by type of home, in one family homes and apartment houses. For one family homes, the same pattern as in most previous analyses is shown, with an elevated relative risk for leukemia, that is higher in the highest exposure category. For apartment houses, no excess risk is evident but again small numbers makes the estimated leukemia relative risks unstable. Tables 4.22 and 4.23 look for a time trend. These analyses indicate that the leukemia excess risk might be more evident in the later time period, but there are only three leukemia cases with more than $0.1 \mu\text{T}$ in the earlier time period.

Second, some analyses on cancer risk and magnetic field assessments based on the spot measurements are presented. Table 4.24 is similar to Table 4.1 the only difference being that in Table 4.24 the exposure assessments are based on the spot measurements. The magnetic field in each home is taken as the average of the low power measurements across the rooms. There is no excess risk for total cancer or for leukemia. For brain cancer the relative risk is estimated at 2.5 (0.9-6.6) for the intermediate exposure level but at 1.5 (0.4-4.9) for the highest exposure group. When data are broken down in subjects residing in Stockholm county and outside Stockholm county the same pattern emerges (Tables 4.25 and 4.26) and also when data are broken down in one family homes and apartment houses (Tables 4.27 and 4.28) or in year of diagnosis (Tables 4.29 and 4.30).

Third, the cancer risk was also analyzed in relation to distance between the home and the power line. The reference category was taken as more than 100 meters. The intermediate exposure category was defined as homes within 51-100 meters from the power line and the highest exposure category was defined as those living in homes closer than 50 meters.

Table 4.31 shows an elevated leukemia relative risk for those living closer than 50 meters estimated at 2.9 (1.0-7.3). In Tables 4.32 and 4.33, data are stratified according to type of home. The results indicate that the relative risk elevation might be more evident in the one family homes.

Tables 4.34 and 4.35 display results of analyses with the subjects divided into those who live in Stockholm county and those who live outside. There is still an elevated relative risk for those living closer than 50 meters, which in essence the same in and outside Stockholm county.

In Tables 4.36 and 4.37 the results are given by year of diagnosis. For all cancer or for brain tumour there is little evidence for an association. For leukemia, there seems to be an association with distance, but only for the later diagnostic period.

Tables 4.38 and 4.39 display the results from the analyses with adjustment for socioeconomic status and car exhaust, respectively. For brain tumours and socioeconomic status the logistic regression analysis iterations did not converge and, hence, the Mantel-Haenszel technique was used. It does not appear from these analyses that either of these potential confounders in fact was a confounder, but the results are vitually unchanged after these adjustments.

Table 4.40, finally, gives the results of the matched analysis, based on conditional regression analysis. Except for some fluctuations, most likely due to chance, the results are the same as in the previous analyses.

Magnetic fields and leukemia and brain tumour in adults

The analyses on magnetic fields and leukemia and brain tumour in adults are presented in a similar way as for children. The results are displayed in the Tables 5.1 and forward. Again, results are presented in several different ways in an attempt to provide as much as possible of the original information.

The first part of Table 5.1 gives data for all leukemia together and separately for each of the four types of leukemia considered in this report and the second part of the table gives the corresponding information for brain tumours. In this table, subjects are classified according to the historical calculated field closest in time to diagnosis based on the cut off points 0.1 and 0.2 μ T. For AML and CML, the relative risk in the highest exposure category was estimated at 1.7 (0.8-3.5) and 1.7 (0.7-

3.8), respectively. For other diagnostic categories or exposure levels there were no noticeable risk elevations. Just as for the children, the results are also presented with other cut off points in order to illustrate to what extent the results are sensitive to the choice of limits. Thus, Tables 5.2-5.5 give the results from these analyses. However, this exercise does not seem to change the results in any material way and it must be kept in mind that numbers in some categories shrink considerably when the cut off point is moved upwards.

Tables 5.6-5.8 give the same type of information but the calculated fields are now based on the situation one, five, and ten years prior to diagnosis. For AML the relative risk is 1.1 when calculated from the exposure one year before diagnosis, otherwise the results are similar to those based on the situation at the time of diagnosis, except that the relative risks for AML and CML tend to increase with time to diagnosis. At ten years before diagnosis the relative risks were estimated at 2.1 (0.7-5.3) and 2.9 (1.0-7.3) for AML and CML, respectively. For astrocytoma III-IV, there was an increased relative risk five years prior to diagnosis in the intermediate exposure category, but not otherwise.

The next set of analyses considered the time or duration of residence in the power line corridor. In Table 5.9, only those who lived near the line at the time of diagnosis are considered. This leaves the results unchanged with relative risk estimates for both AML and CML of 1.9, but with the other relative risks close to or below unity. Tables 5.10 and 5.11 separate subjects in those who lived more or less than ten years at a home within the power line corridor. Here numbers tend to shrink, but the AML and CML relative risks are higher for those with 10 or more years in a home near a power line than for those in other homes. Table 5.12 is restricted to those subjects who lived in the power line corridor at the time of diagnosis and who had lived in the corridor for at least 10 years. This analysis gives results similar to the previous ones, with relative risks for AML and CML estimated at 2.1 (0.6-6.3) and 2.2 (0.6-6.6).

Tables 5.13 and 5.14 are again based on calculated magnetic fields closest in time to diagnosis and separate males and females. There does not appear to be any essential differences between the sexes. Tables 5.15 and 5.16 are similar, except that they provide stratification by age of diagnosis. The results are somewhat erratic and difficult to interpret, but there is no clear evidence for an age difference.

In Tables 5.17 - 5.20, the data are stratified according to area of living or type of house. The

stratification in area of living separates those living in Stockholm county from those living in other parts of Sweden. There seems to be a tendency with higher relative risks outside Stockholm for the two leukemia groups that have shown risk increases in the previous analyses. For AML and CML, respectively the relative risks outside Stockholm were 2.4 (0.5-8.3) and 3.9 (1.0-12.3) versus 1.5 (0.5-3.4) and 1.0 (0.2-3.0) in Stockholm. However, this is based on small numbers as indicated by the width of the confidence intervals. It is also noteworthy, that for those living outside Stockholm, the astrocytoma III-IV relative risk was estimated at 1.9 (0.8-4.3) in the intermediate category and at 1.5 (0.5-4.0) in the highest exposure category. There was a corresponding tendency with higher AML and CML relative risks for those living in one-family homes as compared to those living in apartment houses.

Tables 5.21 and 5.22 gives the result by year of diagnosis, but there is little evidence for a time trend in the relative risks based on these analyses.

In Tables 5.23 and 5.24, the results based on spot measurements and distance are presented. Although the CML relative risk is high for those living within 50 meters, these results are less clear than those from the previous analyses based on historical calculations.

Table 5.25 presents the results after adjustment for socioeconomic status. These results give little evidence for confounding from socioeconomic status, since they are similar to the crude results in Table 5.1.

Finally, Table 5.26 gives the results from the matched analysis. No data are presented for ALL, since the iterations did not converge for this group.

DISCUSSION

For leukemia in children and exposure defined from calculated historical fields, this study shows increased relative risks, which increase with level of exposure. These results persist when data are stratified according to gender, age, area of living, or time of diagnosis, but the association seems to be confined to one family homes. Similar results are obtained when exposure is defined from proximity to the power line. However, there are no associations between spot measurements and

leukemia risk. For brain tumours in children, there is little evidence in this study for an association with the calculated historical fields or with proximity to the line. However, for spot measurements, the relative risk in the intermediate exposure level is increased. In adults, there is a tendency for an association between historical calculated fields and both AML and CML. For brain tumours in adults, there is little evidence for an association with any of the exposure metrics applied in this study.

The study has several features that are worth consideration when interpreting these findings. First, the study is a population based case control study nested within a well defined study base. Identification of the study base as well as of cases and controls took advantage of the population registry system in Sweden. Thus, if no subjects were missed selection bias would be minimized. As for identification of the people in the power line corridor, two lines in Stockholm had to be skipped together with a handful of parishes in different parts of the country. It is difficult to imagine, however, that this could do anything to the accuracy of the study, except making the number of subjects somewhat smaller. As for obtaining information pertinent to exposure estimation, we were successful with one exception. Spot measurements were only performed in about two thirds of the homes of the children and in half of the homes of the adults. This, of course, can not affect the results based on the calculated historical fields. To what extent it affects the analyses in which the spot measurements are involved is not known. There is, however, no indication that the homes with no measurements were selected in any special way, except that the majority came from Stockholm and that priority was given to measure homes of children.

Second, the population on which the case-control study was performed, was the population of people living on properties within a specified distance from Sweden's major transmission lines. Thus, magnetic fields generated from high voltage power lines were the major source of exposure to the subjects in the study. This was a prerequisite for the method by which the historical magnetic fields were calculated. In addition, the use of the cohort around the power lines enhanced the study efficiency, since it resulted in a high proportion of exposed subjects. As discussed, transmission lines are the most important source of exposure in this study. It is an important issue, whether this implies that the subjects in this study have a type of exposure that differs in an etiologically relevant way from that of subjects in previous studies.

Exposure was assessed in various ways for the subjects in the study. The exposure metric, that was used for most of the analyses can best be described as the annual average of the magnetic field in the

subject's home as generated by the power line. The basis for choosing this was, that the agreement between spot measurements and fields calculated at the time of the spot measurements were reasonably good. This was taken as an indication that the calculations actually could predict in home fields with a certain degree of accuracy. An alternative would have been to use the spot measurements. However, the comparison between the calculated historical fields and the spot measurements showed a poor agreement. This was taken as an indication that contemporary fields would not be accurate as predictors of past fields.

This strategy for exposure assessment implied that only the transmission line fields could be accounted for. It was evident, of course, that the subjects in the study were exposed also to fields generated by other sources. First, there were other fields in the homes from sources such as appliances and unbalanced return currents. By comparing calculated contemporary fields to spot measurements, one can obtain an indication of the number of homes where such fields might play a role for classifying subjects according to exposure category. It might even be possible to construct a model that combines this type of information and the calculated historical fields, but it is not obvious how this should be done. Second, people are not spending all their time at home and they are subject to magnetic field exposure at school, at work, at other places, or in between. The 24 hour measurements provide an attempt to estimate the magnetic field exposure outside home relative to that at home. This is done by comparing the 24 hour measurements to the spot measurements. Again, it might be possible to construct a model that takes exposure outside home into consideration. Some details from these comparisons are provided in the tables in Section 3. The general impression of these comparisons is that the agreements are acceptable and that the calculated historical field provide a reasonable estimate of the magnetic field level in the home. It is also important to realize that if some magnetic field sources are ignored in the exposure assessment, with the same probability for cases and controls, it should not give rise to spurious associations between magnetic field and cancer but only to dilution of associations.

The associations seen in the present study between calculated historical fields and leukemia in children are rather consistent. There is a dose-response pattern and the relationship is similar when data are broken down according to basic demographic characteristics, but stratification for type of home showed that the relationship was confined to one family homes. Control for some potential confounders does not change the results. The findings could be due to chance but this is less likely with the observed magnitude of the relative risks, the obtained confidence limits, the dose-response

pattern, and the consistency of the findings. It is also difficult to think of a systematic error related to exposure assessment or selection of subjects that may have generated these results, especially since the findings only apply to one of the diagnostic groups. Confounding is certainly a possibility, but it is unlikely that any of the few risk factors that are known today might explain the results. That an association is seen with calculated historical fields and distance is consistent with the assumption that calculated historical fields are reasonably good predictors of past exposure, in the homes in this study, and that distance is highly correlated with the calculated field. By the same token, the lack of an association with spot measurements is consistent with the assumption that contemporary fields are poor predictors of past exposure. One can only speculate about the reasons why the excess risk is concentrated to one family homes. It is noteworthy, however, that it would only take the shifting of one case from the lowest to the highest exposure category, among those in apartment homes, in order to produce a relative risk of 1.8. Furthermore, there are several arguments why the precision of the calculated fields may be lower for apartment houses than for one family homes. A separate analysis provided support for this. When contemporary calculated fields were cross tabulated by spot measurements with stratification for one family house or apartment house it was evident that the agreement was considerably better for the one family houses (Tables 3.8 and 3.10).

The results for leukemia in children are rather consistent with the findings by Savitz et al. (1988) and by London et al. (1991). Both those studies found relationships to wire codes (an approach to magnetic field exposure assessment) but no or weak relationships to spot measurements. In the present study, the historic calculated fields gave at least as strong associations as the wire codes in those studies, while the spot measurements not even gave an indication to an association. The calculated historic fields in the present study can be considered a refined wire coding, that takes more factors into consideration and in a more detailed way. At the same time, the performance of the spot measurements might be less accurate than in previous studies, since they would have to predict fields over an even longer time span. Although the results of the other previous studies on childhood leukemia and residential exposure are more uncertain due to difficulties in the design or to small numbers of exposed subjects, it is noteworthy that the results of the present study are quite similar to the original Wertheimer-Leeper findings (Savitz and Ahlbom, in press; Coleman et al. 1989; Fulton et al. 1980; Myers et al. 1990; Wertheimer and Leeper, 1979).

For brain tumours in children, there was no association between relative risk and calculated fields or proximity to the line. However, for the spot measurements the group with exposure at the

intermediate level showed a relative risk in the order of two, while the highest exposure category only showed a moderately elevated relative risk. There are several possible explanations to this result and chance is, indeed, one of them. However, it turns out that the cases in the intermediate exposure category are living far away from the power line. Thus, the explanation to the high spot measured fields is not the transmission line but some other source, not necessarily generating predominantly 50 Hz sinusoidal fields. There are three previous studies on childhood brain tumours and residential magnetic fields and, in conflict with the present study, they all gave some support for a relationship (Wertheimer and Leeper, 1979; Tomenius, 1986; Savitz et al., 1988).

In adults, there is a tendency towards an association between historic calculated fields and acute and chronic myeloid leukemia, but this tendency is not as clear as for the association with leukemia in children. It is not really a dose-response relationship but the risk elevation is only seen in the highest exposure category. It is worth noting that there are indications that the association might be stronger for past exposure than for more recent and that it might increase with duration of exposure. For the brain tumours in adults, there are some analyses that indicate an increased relative risk in the intermediate exposure category for calculated historical fields, but these data are erratic and impossible to draw any conclusions from. There are five previous studies on residential exposure and cancer in adults and taken together they give little support for a relationship and especially for leukemias there is little support (Coleman et al., 1989; McDowall, 1986; Severson et al., 1988; Wertheimer and Leeper, 1982; Youngson et al., 1991). Most previous evidence for an association between magnetic fields and leukemia in adults comes from the occupational literature (Savitz and Ahlbom, in press).

Overall, it seems that the results of this study provides more support for an association between magnetic fields and cancer development than against it. The evidence for this is most clear for childhood leukemia. What characteristic of the magnetic field that would be involved remains unclear, although some indications might be derived from the fact that transmission lines were the major exposure source in this study.

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Table 1. Demographic characteristics of the people in the study base

Item	N
Total	436 503
Sex	
Male	220 423
Female	215 820
Age at entering the study base	
0- 4	73 053
5- 9	28 323
10-14	22 043
15-19	28 141
20-29	114 185
39-39	63 238
40-49	37 392
50-59	25 496
60-69	16 114
70-	9 813
unknown	18 705
Area	
Stockholm	241 964
Rest of Sweden	194 539
Time period	
1960-69	188 513
1970-79	347 652
1980-85	412 642

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Table 2.2 Cancer cases by diagnosis

Children	
Leukemia	39
acute lymphatic leukemia	22
acute blast leukemia	7
acute myeloid leukemia	4
chronic myeloid leukemia	1
unspecified	5
Brain tumours	33
astrocytoma	14
medulloblastoma	7
craniopharyngioma	3
ponsglioma	2
other	7
Lymphoma	19
Kidney (Wilm's tumour)	10
Other	41
Total	142
Adults	
Leukemia	325
acute myeloid leukemia	72
chronic myeloid leukemia	57
acute lymphatic leukemia	14
chronic lymphatic leukemia	132
other	50
Brain tumours	223
astrocytoma I-II	66
astrocytoma III-IV	157

Table 2.1 Number of cases and controls

	children		adults	
	cases	controls	cases	controls
Identified	142	558	548	1091
No calculated fields	1	4	2	8
No measured fields	53	214	255	503

Table 2.4 Demographic characteristics of subjects, adults

Item	Leukemia	Brain tumor	Controls
Total	325	223	1091
Sex			
Male	199	138	658
Female	126	85	433
Age at diagnosis			
16-39	38	53	186
40-59	80	80	304
60-	207	90	601
Area			
Stockholm	206	143	695
Rest of Sweden	119	80	396
Time period			
1960-74	112	81	381
1975-85	213	142	710

Table 2.3 Demographic characteristics of subjects, children

Item	Cases	Controls
Total	142	558
Sex		
Male	74	299
Female	68	259
Age at diagnosis		
0- 4	54	208
5- 9	35	146
10-15	53	204
Area		
Stockholm	81	323
Rest of Sweden	61	235
Time period		
1960-74	67	264
1975-85	75	294

Table 3.1 Low-power measurements by time of the year, %

μT	Jan- April	May- Aug.	Sept.- Dec.
0-0.09	58	66	64
0.1-0.19	21	14	16
0.2-0.29	8	5	6
0.3-	14	15	14
N	505	213	596

Contemporary calculations by time of the year, %

μT	Jan- April	May- Aug.	Sept.- Dec.
0-0.09	72	79	77
0.1-0.19	13	7	9
0.2-0.29	4	3	3
0.3-	11	11	12
N	497	209	537

Table 2.5 Duration of residence within the corridor

children

	cases	controls
Number of years, mean	4.13	4.10
Proportion of child's life before diagnosis within the corridor	0.63	0.60

adults

	cases	controls
Number of years, mean	15.7	15.9
Proportion of subject's life before diagnosis within the corridor	0.27	0.27

Table 3.3 Historical calculations by type of building, %

μT	One family houses	Apartment houses
0-0.09	84	87
0.1-0.19	8	6
0.2-0.29	3	2
0.3-	5	5
N	1048	1276

Table 3.2 Low-power measurements by type of building, %

μT	One family houses	Apartment houses
0-0.09	73	50
0.1-0.19	14	22
0.2-0.29	4	9
0.3-	9	19
N	688	626

Contemporary calculations by type of building, %

μT	One family houses	Apartment houses
0-0.09	79	72
0.1-0.19	9	12
0.2-0.29	3	3
0.3-	10	13
N	677	623

Table 3.5 Historical calculations by region, %

μT	All	Stockholm	Sweden excl. Stockholm
0-0.09	85	85	86
0.1-0.19	7	6	8
0.2-0.29	3	2	3
0.3-	5	6	4
N	2324	1445	879
Average (μT)	0.07	0.08	0.06

Table 3.4 Low-power measurements by region, %

μT	All	Stockholm	Sweden excl. Stockholm
0-0.09	62	53	75
0.1-0.19	18	21	13
0.2-0.29	6	8	4
0.3-	14	18	8
N	1314	769	545
Average (μT)	0.18	0.23	0.10

Contemporary calculations by region, %

μT	All	Stockholm	Sweden excl. Stockholm
0-0.09	76	70	84
0.1-0.19	10	13	7
0.2-0.29	3	4	2
0.3-	11	14	8
N	1300	763	537
Average (μT)	0.15	0.20	0.08

Table 3.8 Comparison between calculated contemporary fields and spot measurements, one family houses

Spot measurements	Calculated contemporary fields			
	μT	0.2-	0.1-0.19	0-0.09
0.2-		78	7	7
0.1-0.19		8	40	44
0-0.09		0	11	482

Table 3.9 Comparison between calculated historical fields and spot measurements, one family houses

Spot measurements	Calculated historical fields			
	μT	0.2-	0.1-0.19	0-0.09
0.2-		53	18	23
0.1-0.19		6	24	65
0-0.09		5	16	478

Table 3.6 Comparison between calculated contemporary fields and spot measurements

		Calculated contemporary fields		
		μT	0.2-	0.1-0.19
Spot measure- ments	0.2-	169	39	57
	0.1-0.19	14	71	142
	0-0.09	1	24	783

Table 3.7 Comparison between calculated historical fields and spot measurements

		Calculated historical fields		
		μT	0.2-	0.1-0.19
Spot measure- ments	0.2-	116	41	111
	0.1-0.19	7	37	187
	0-0.09	5	20	790

Table 4.1 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.2 μT

Diagnosis	0-0.09 μT		0.1-0.19 μT		0.2- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	117	1	12	1.5 (0.7-2.9)	12	1.1 (0.5-2.1)
Leukemia	27	1	4	2.1 (0.6-6.1)	7	2.7 (1.0-6.3)
Brain tumor	29	1	2	1.0 (0.2-3.8)	2	0.7 (0.1-2.7)
Controls	475		33		46	

Table 4.2 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.15 μT

Diagnosis	0-0.09 μT		0.1-0.14 μT		0.15- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	117	1	9	2.1 (0.9-4.9)	15	1.0 (0.5-1.8)
Leukemia	27	1	3	3.1 (0.7-10.5)	8	2.3 (0.9-5.1)
Brain tumor	29	1	2	1.9 (0.3-7.7)	2	0.5 (0.1-2.0)
Controls	475		17		62	

Table 3.10 Comparison between calculated contemporary fields and spot measurements, apartment houses

		Calculated contemporary fields		
		μT	0.2-	0.1-0.19
Spot measure- ments	0.2-	91	32	50
	0.1-0.19	6	31	98
	0-0.09	1	13	301

Table 3.11 Comparison between calculated historical fields and spot measurements, apartment houses

		Calculated historical fields		
		μT	0.2-	0.1-0.19
Spot measure- ments	0.2-	63	23	88
	0.1-0.19	1	13	122
	0-0.09	0	4	312

Table 4.5 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, cut-off point at 0.1 μT

Diagnosis	0-0.09 μT		0.1- μT	
	n	RR	n	RR (95% CI)
All cancer	117	1	24	1.2 (0.7-2.0)
Leukemia	27	1	11	2.4 (1.2-5.1)
Brain tumor	29	1	4	0.8 (0.2-2.3)
Controls	475		79	

Table 4.3 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.25 μT

Diagnosis	0-0.09 μT		0.1-0.24 μT		0.25- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	117	1	13	1.3 (0.7-2.4)	11	1.2 (0.6-2.4)
Leukemia	27	1	4	1.7 (0.5-4.7)	7	3.3 (1.3-7.9)
Brain tumor	29	1	2	0.8 (0.1-2.9)	2	0.9 (0.1-3.3)
Controls	475		42		37	

Table 4.4 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.3 μT

Diagnosis	0-0.09 μT		0.1-0.29 μT		0.3- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	117	1	14	1.2 (0.6-2.3)	10	1.3 (0.6-2.7)
Leukemia	27	1	4	1.5 (0.4-4.2)	7	3.8 (1.4-9.3)
Brain tumor	29	1	2	0.7 (0.1-2.6)	2	1.0 (0.2-3.9)
Controls	475		47		32	

Table 4.8 Cancer risk in children in relation to calculated fields ten years before diagnosis.

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	53	1	1	0.9 (0.0-7.7)	1	0.6 (0.0-4.4)
Leukemia	6	1	0	0.0 (0.0-43.1)	1	5.5 (0.2-45.9)
Brain tumor	18	1	0	0.0 (0.0-13.0)	0	0.0 (0.0-7.6)
Controls	199		4		6	

Table 4.6 Cancer risk in children in relation to calculated fields one year before diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	86	1	6	1.0 (0.4-2.5)	8	1.1 (0.5-2.4)
Leukemia	22	1	1	0.7 (0.0-3.9)	5	2.7 (0.8-7.3)
Brain tumor	17	1	1	0.9 (0.0-5.2)	2	1.4 (0.2-5.5)
Controls	341		23		29	

Table 4.7 Cancer risk in children in relation to calculated fields five years before diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	70	1	5	1.6 (0.5-4.5)	3	0.9 (0.2-2.9)
Leukemia	13	1	0	0.0 (0.0-6.4)	2	3.2 (0.4-14.0)
Brain tumor	20	1	1	1.1 (0.0-6.8)	1	1.0 (0.0-6.3)
Controls	288		13		14	

Table 4.11 Cancer risk in children in relation to calculated magnetic fields at birth, Restricted to children who lived near a power line at birth

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	61	1	7	1.9 (0.7-5.0)	4	0.7 (0.2-2.2)
Leukemia	17	1	1	1.0 (0.0-6.1)	1	0.7 (0.0-4.0)
Brain tumor	16	1	1	1.0 (0.0-6.6)	1	0.7 (0.0-4.3)
Controls	216		13		19	

Table 4.12 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, restricted to children who have lived at least 50 % of their life before diagnosis in the house near a power line

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	65	1	5	0.9 (0.3-2.3)	8	1.2 (0.5-2.8)
Leukemia	18	1	2	1.3 (0.2-5.1)	4	2.2 (0.6-6.8)
Brain tumor	12	1	1	0.9 (0.0-5.9)	1	0.8 (0.0-5.1)
Controls	261		23		26	

Table 4.9 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, only those who lived near the power line at the time of diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	83	1	5	0.9 (0.3-2.3)	9	1.1 (0.5-2.3)
Leukemia	21	1	2	1.4 (0.2-5.6)	5	2.4 (0.7-6.4)
Brain tumor	17	1	0	0.0 (0.0-3.1)	2	1.2 (0.2-4.6)
Controls	326		22		33	

Table 4.10 Cancer risk in children in relation to calculated magnetic fields for the year of diagnosis, restricted to children who have lived at the same address from birth to diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	38	1	2	0.5 (0.1-1.9)	4	0.8 (0.2-2.5)
Leukemia	9	1	1	1.0 (0.0-6.7)	1	0.9 (0.0-5.8)
Brain tumor	7	1	0	0.0 (0.0-5.2)	1	1.1 (0.0-7.8)
Controls	124		14		16	

Table 4.15 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, restricted to ages 0-4

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	46	1	2	1.0 (0.1-4.4)	6	1.2 (0.4-3.2)
Leukemia	17	1	2	2.7 (0.4-12.6)	3	1.7 (0.4-5.9)
Brain tumor	6	1	0	0.0 (0.0-17.6)	0	0.0 (0.0-6.6)
Controls	181		8		19	

Table 4.16 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, restricted to ages 5-9

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	28	1	3	1.7 (0.3-6.6)	4	1.6 (0.4-5.4)
Leukemia	6	1	1	2.6 (0.1-20.8)	3	5.7 (1.0-26.0)
Brain tumor	9	1	1	1.8 (0.1-12.8)	1	1.3 (0.1-8.9)
Controls	126		8		11	

Table 4.13 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, only boys

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	64	1	4	1.3 (0.4-4.2)	6	0.8 (0.3-2.0)
Leukemia	13	1	1	1.7 (0.1-10.8)	3	2.1 (0.4-7.2)
Brain tumor	15	1	0	0.0 (0.0-5.3)	1	0.6 (0.0-3.5)
Controls	258		12		29	

Table 4.14 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, only girls

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	53	1	8	1.6 (0.6-3.7)	6	1.4 (0.5-3.8)
Leukemia	14	1	3	2.2 (0.5-7.8)	4	3.6 (0.9-11.9)
Brain tumor	14	1	2	1.5 (0.2-6.2)	1	0.9 (0.0-5.7)
Controls	217		21		17	

Table 4.18 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, Stockholm county

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	69	1	6	1.5 (0.5-3.9)	6	0.8 (0.3-1.9)
Leukemia	13	1	2	2.7 (0.4-11.5)	3	2.1 (0.4-7.1)
Brain tumor	14	1	1	1.2 (0.1-7.7)	0	0.0 (0.0-2.2)
Controls	276		16		31	

Table 4.19 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, Sweden excl. Stockholm county

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	48	1	6	1.5 (0.5-3.8)	6	1.7 (0.6-4.4)
Leukemia	14	1	2	1.7 (0.2-7.2)	4	3.8 (1.0-12.5)
Brain tumor	15	1	1	0.8 (0.0-4.8)	2	1.8 (0.3-7.6)
Controls	199		17		15	

Table 4.17 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, restricted to ages 10-15

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	43	1	7	1.6 (0.6-4.1)	2	0.5 (0.1-1.9)
Leukemia	4	1	1	2.5 (0.1-20.8)	1	2.6 (0.1-22.2)
Brain tumor	14	1	1	0.7 (0.0-4.4)	1	0.8 (0.0-4.7)
Controls	168		17		16	

Table 4.22 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, restricted to children diagnosed 1960-74

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	59	1	1	0.3 (0.0-1.9)	6	0.9 (0.3-2.1)
Leukemia	16	1	0	0.0 (0.0-4.3)	3	1.6 (0.4-5.5)
Brain tumor	14	1	1	1.3 (0.1-8.6)	1	0.6 (0.0-3.7)
Controls	223		12		26	

Table 4.23 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, restricted to children diagnosed 1975-85

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	58	1	11	2.3 (1.0-4.9)	6	1.3 (0.5-3.3)
Leukemia	11	1	4	4.4 (1.1-14.5)	4	4.6 (1.2-15.3)
Brain tumor	15	1	1	0.8 (0.0-4.8)	1	0.8 (0.0-5.1)
Controls	252		21		20	

Table 4.20 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, restricted to one family houses

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	50	1	9	2.0 (0.8-4.6)	8	1.8 (0.7-4.2)
Leukemia	10	1	4	4.5 (1.1-15.2)	5	5.6 (1.6-17.8)
Brain tumor	18	1	0	0.0 (0.0-2.2)	2	1.2 (0.2-5.1)
Controls	224		20		20	

Table 4.21 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, restricted to apartment houses

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	67	1	3	0.9 (0.2-2.9)	4	0.6 (0.2-1.6)
Leukemia	17	1	0	0.0 (0.0-4.2)	2	1.1 (0.2-4.6)
Brain tumor	11	1	2	3.5 (0.5-16.0)	0	0.0 (0.0-3.2)
Controls	251		13		26	

Table 4.25 Cancer risk in children in relation to spot measurements, Stockholm county

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	24	1	16	1.5 (0.7-3.0)	12	0.9 (0.4-1.9)
Leukemia	6	1	1	0.4 (0.0-2.6)	3	0.9 (0.2-3.8)
Brain tumor	5	1	5	2.2 (0.6-8.5)	3	1.1 (0.2-4.8)
Controls	97		44		54	

Table 4.26 Cancer risk in children in relation to spot measurements, Sweden excl. Stockholm county

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	29	1	4	0.7 (0.2-2.0)	4	0.9 (0.3-2.9)
Leukemia	13	1	0	0.0 (0.0-1.3)	1	0.5 (0.0-3.4)
Brain tumor	5	1	3	2.9 (0.5-13.2)	2	2.8 (0.3-15.1)
Controls	110		23		16	

Table 4.24 Cancer risk in children in relation to spot measurements

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	53	1	20	1.2 (0.7-2.1)	16	0.9 (0.5-1.7)
Leukemia	19	1	1	0.2 (0.0-0.9)	4	0.6 (0.2-1.8)
Brain tumor	10	1	8	2.5 (0.9-6.6)	5	1.5 (0.4-4.9)
Controls	207		67		70	

Table 4.29 Cancer risk in children in relation to spot measurements, restricted to children diagnosed 1960-74

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	24	1	10	0.9 (0.4-2.1)	6	0.5 (0.2-1.2)
Leukemia	9	1	0	0.0 (0.0-0.9)	1	0.2 (0.0-1.4)
Brain tumor	4	1	4	2.2 (0.5-10.1)	3	1.4 (0.3-7.2)
Controls	74		34		39	

Table 4.30 Cancer risk in children in relation to spot measurements, restricted to children diagnosed 1975-85

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	29	1	10	1.4 (0.6-3.1)	10	1.5 (0.7-3.4)
Leukemia	10	1	1	0.4 (0.1-2.5)	3	1.3 (0.3-4.7)
Brain tumor	6	1	4	2.7 (0.6-10.3)	2	1.4 (0.2-7.1)
Controls	133		33		31	

Table 4.27 Cancer risk in children in relation to spot measurements, restricted to one family houses

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	33	1	7	1.0 (0.4-2.5)	5	0.8 (0.3-2.3)
Leukemia	11	1	1	0.4 (0.0-2.7)	2	1.0 (0.1-4.4)
Brain tumor	8	1	3	1.8 (0.4-7.0)	2	1.4 (0.2-6.5)
Controls	129		27		23	

Table 4.28 Cancer risk in children in relation to spot measurements, restricted to apartment houses

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	20	1	13	1.3 (0.6-2.8)	11	0.9 (0.4-2.1)
Leukemia	8	1	0	0.0 (0.0-0.9)	2	0.4 (0.1-1.9)
Brain tumor	2	1	5	4.9 (0.9-37.2)	3	2.5 (0.4-21.4)
Controls	78		40		47	

Table 4.32 Cancer risk in children in relation to distance to power line, restricted to one family houses

Diagnosis	101- m		51-100 m		0-50 m	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	52	1	10	0.9 (0.4-1.9)	5	1.4 (0.4-4.0)
Leukemia	12	1	3	1.2 (0.3-4.1)	4	4.9 (1.2-16.7)
Brain tumor	16	1	3	0.9 (0.2-2.9)	1	0.9 (0.0-5.8)
Controls	206		44		14	

Table 4.33 Cancer risk in children in relation to distance to power line, restricted to apartment houses

Diagnosis	101- m		51-100 m		0-50 m	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	58	1	12	1.0 (0.5-2.1)	4	0.8 (0.2-2.2)
Leukemia	14	1	3	1.1 (0.2-3.6)	2	1.6 (0.2-6.8)
Brain tumor	9	1	4	2.2 (0.6-7.4)	0	0.0 (0.0-4.8)
Controls	225		45		20	

Table 4.31 Cancer risk in children in relation to distance to power line

Diagnosis	101- m		51-100 m		0-50 m	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	110	1	22	1.0 (0.6-1.6)	9	1.0 (0.5-2.2)
Leukemia	26	1	6	1.1 (0.4-2.7)	6	2.9 (1.0-7.3)
Brain tumor	25	1	7	1.4 (0.5-3.1)	1	0.5 (0.0-2.8)
Controls	431		89		34	

Table 4.36 Cancer risk in children in relation to distance to power line, restricted to children diagnosed 1960-74

Diagnosis	101- m		51-100 m		0-50 m	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	52	1	10	0.8 (0.4-1.8)	4	0.7 (0.2-2.1)
Leukemia	14	1	3	0.9 (0.2-3.2)	2	1.3 (0.2-5.6)
Brain tumor	12	1	3	1.1 (0.2-3.8)	1	0.8 (0.0-4.8)
Controls	195		45		21	

Table 4.37 Cancer risk in children in relation to distance to power line, restricted to children diagnosed 1975-85

Diagnosis	101- m		51-100 m		0-50 m	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	58	1	12	1.1 (0.6-2.2)	5	1.6 (0.5-4.5)
Leukemia	12	1	3	1.3 (0.3-4.7)	4	6.1 (1.5-20.8)
Brain tumor	13	1	4	1.6 (0.4-5.1)	0	0.0 (0.0-5.2)
Controls	236		44		13	

Table 4.34 Cancer risk in children in relation to distance to power line, restricted to Stockholm county

Diagnosis	101- m		51-100 m		0-50 m	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	65	1	11	0.9 (0.5-1.9)	5	0.8 (0.3-2.2)
Leukemia	13	1	2	0.8 (0.1-3.5)	3	2.5 (0.5-9.0)
Brain tumor	13	1	2	0.8 (0.1-3.5)	0	0.0 (0.0-3.0)
Controls	254		46		23	

Table 4.35 Cancer risk in children in relation to distance to power line, restricted to Sweden excl. Stockholm county

Diagnosis	101- m		51-100 m		0-50 m	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
All cancer	45	1	11	1.0 (0.5-2.1)	4	1.4 (0.4-4.6)
Leukemia	13	1	4	1.3 (0.3-3.9)	3	3.7 (0.7-14.4)
Brain tumor	12	1	5	1.7 (0.5-5.0)	1	1.3 (0.1-8.9)
Controls	177		43		11	

Table 4.40 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, matched analysis

Diagnosis	0-0.09 μ T	0.1-0.19 μ T	0.2- μ T	
	RR	RR (95% CI)	n	RR (95% CI)
All cancer	1	1.5 (0.7-3.1)		1.1 (0.5-2.2)
Leukemia	1	4.3 (1.0-18.9)		3.5 (0.9-13.6)
Brain tumor	1	0.8 (0.1-4.9)		0.7 (0.1-3.2)

Table 4.38 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, adjusted for socioeconomic status

Diagnosis	0-0.09 μT	0.1-0.19 μT	0.2- μT	
	RR	RR (95% CI)	n	RR (95% CI)
All cancer	1	1.6 (0.7-3.6)		1.3 (0.6-2.7)
Leukemia	1	1.5 (0.3-6.8)		3.2 (1.2-8.5)
Brain tumor	1	1.6 (0.4-7.2)*		1.0 (0.2-4.5)*

* Mantel-Haenszel technique

Table 4.39 Cancer risk in children in relation to calculated magnetic fields closest in time to diagnosis, adjusted for car exhaust

Diagnosis	0-0.09 μT	0.1-0.19 μT	0.2- μT	
	RR	RR (95% CI)	n	RR (95% CI)
All cancer	1	1.6 (0.8-3.2)		1.1 (0.5-2.1)
Leukemia	1	2.2 (0.7-6.7)		2.6 (1.1-6.3)
Brain tumor	1	1.1 (0.3-4.9)		0.7 (0.2-3.2)

Table 5.2 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.15 μT

Diagnosis	0-0.09 μT		0.1-0.14 μT		0.15- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	278	1	12	0.8 (0.4-1.5)	34	1.0 (0.7-1.6)
AML	58	1	3	0.9 (0.2-2.8)	11	1.6 (0.8-3.2)
CML	45	1	3	1.2 (0.3-3.6)	9	1.7 (0.8-3.5)
ALL	13	1	0	0.0 (0.0-4.8)	1	0.7 (0.0-3.8)
CLL	116	1	4	0.6 (0.2-1.6)	11	0.8 (0.4-1.6)
Controls	924		51		108	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.15 μT

Diagnosis	0-0.09 μT		0.1-0.14 μT		0.15- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	192	1	12	1.1 (0.6-2.2)	18	0.8 (0.5-1.4)
Astrocytoma I-II	60	1	2	0.6 (0.1-2.2)	3	0.4 (0.1-1.2)
Astrocytoma III-IV	132	1	10	1.4 (0.7-2.8)	15	1.0 (0.6-1.7)
Controls	924		51		108	

Table 5.1 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.2 μT

Diagnosis	0-0.09 μT		0.1-0.19 μT		0.2- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	278	1	20	0.9 (0.5-1.5)	26	1.0 (0.7-1.7)
AML	58	1	5	1.0 (0.4-2.5)	9	1.7 (0.8-3.5)
CML	45	1	5	1.4 (0.5-3.3)	7	1.7 (0.7-3.8)
ALL	13	1	0	0.0 (0.0-3.2)	1	0.9 (0.0-5.0)
CLL	116	1	8	0.8 (0.4-1.7)	7	0.7 (0.3-1.4)
Controls	924		76		83	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.2 μT

Diagnosis	0-0.09 μT		0.1-0.19 μT		0.2- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	192	1	18	1.1 (0.7-2.0)	12	0.7 (0.4-1.3)
Astrocytoma I-II	60	1	3	0.6 (0.1-1.8)	2	0.4 (0.1-1.3)
Astrocytoma III-IV	132	1	15	1.4 (0.8-2.5)	10	0.8 (0.4-1.7)
Controls	924		76		83	

Table 5.4 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.3 μT

Diagnosis	0-0.09 μT		0.1-0.29 μT		0.3- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	278	1	28	0.9 (0.6-1.3)	18	1.2 (0.7-2.0)
AML	58	1	11	1.6 (0.8-3.2)	3	0.9 (0.2-2.7)
CML	45	1	7	1.3 (0.5-2.9)	5	2.0 (0.7-4.9)
ALL	13	1	0	0.0 (0.0-2.3)	1	1.4 (0.1-8.0)
CLL	116	1	8	0.6 (0.3-1.2)	7	1.1 (0.4-2.3)
Controls	924		31		52	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.3 μT

Diagnosis	0-0.09 μT		0.1-0.29 μT		0.3- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	192	1	22	1.0 (0.6-1.6)	8	0.7 (0.3-1.5)
Astrocytoma I-II	60	1	4	0.6 (0.2-1.5)	1	0.3 (0.0-1.6)
Astrocytoma III-IV	132	1	18	1.2 (0.7-2.0)	7	0.9 (0.4-2.0)
Controls	924		107		52	

Table 5.3 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.25 μT

Diagnosis	0-0.09 μT		0.1-0.24 μT		0.25- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	278	1	23	0.8 (0.5-1.3)	23	1.2 (0.7-1.9)
AML	58	1	7	1.2 (0.5-2.6)	7	1.7 (0.7-3.7)
CML	45	1	6	1.3 (0.5-3.0)	6	1.9 (0.7-4.3)
ALL	13	1	0	0.0 (0.0-2.6)	1	1.1 (0.0-6.3)
CLL	116	1	8	0.7 (0.3-1.4)	7	0.8 (0.4-1.8)
Controls	924		17		66	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off points at 0.1 and 0.25 μT

Diagnosis	0-0.09 μT		0.1-0.24 μT		0.25- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	192	1	20	1.0 (0.6-1.7)	10	0.7 (0.4-1.4)
Astrocytoma I-II	60	1	4	0.7 (0.2-1.7)	1	0.2 (0.0-1.2)
Astrocytoma III-IV	132	1	16	1.2 (0.7-2.1)	9	1.0 (0.4-1.9)
Controls	924		93		66	

Table 5.6 Leukemia risk in relation to calculated magnetic fields one year before diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	177	1	19	1.6 (0.9-2.7)	17	0.9 (0.5-1.7)
AML	37	1	6	2.3 (0.9-5.6)	4	1.1 (0.3-2.9)
CML	28	1	4	2.1 (0.6-5.8)	5	1.8 (0.6-4.5)
ALL	7	1	0	0.0 (0.0-7.9)	0	0.0 (0.0-5.4)
CLL	79	1	8	1.5 (0.6-3.1)	6	0.7 (0.3-1.7)
Controls	592		41		60	

Brain tumor risk in relation to calculated magnetic fields one year before diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	115	1	10	1.3 (0.6-2.6)	8	0.7 (0.3-1.4)
Astrocytoma I-II	39	1	2	0.7 (0.1-2.7)	1	0.3 (0.0-1.4)
Astrocytoma III-IV	76	1	8	1.5 (0.6-3.3)	7	0.9 (0.4-2.0)
Controls	592		41		60	

Table 5.5 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off point at 0.1 μ T

Diagnosis	0-0.09 μ T		0.1- μ T	
	n	RR	n	RR (95% CI)
Leukemia	278	1	46	1.0 (0.7-1.4)
AML	58	1	14	1.4 (0.8-2.6)
CML	45	1	12	1.6 (0.8-3.0)
ALL	13	1	1	0.4 (0.0-2.6)
CLL	116	1	15	0.8 (0.4-1.3)
Controls	924		159	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, cut-off point at 0.1 μ T

Diagnosis	0-0.09 μ T		0.1- μ T	
	n	RR	n	RR (95% CI)
Brain tumor	192	1	30	0.9 (0.6-1.4)
Astrocytoma I-II	60	1	5	0.5 (0.2-1.1)
Astrocytoma III-IV	132	1	25	1.1 (0.7-1.6)
Controls	924		159	

Table 5.8 Leukemia risk in relation to calculated magnetic fields ten years before diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	254	1	13	1.1 (0.6-2.2)	17	1.6 (0.9-2.9)
AML	56	1	2	0.8 (0.1-2.9)	5	2.1 (0.7-5.3)
CML	41	1	3	1.6 (0.4-5.0)	5	2.9 (1.0-7.3)
ALL	11	1	0	0.0 (0.0-7.3)	1	2.1 (0.1-13.0)
CLL	105	1	7	1.5 (0.6-3.3)	5	1.1 (0.4-2.8)
Controls	874		39		37	

Brain tumor risk in relation to calculated magnetic fields ten years before diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	184	1	7	0.9 (0.4-1.9)	4	0.5 (0.2-1.4)
Astrocytoma I-II	60	1	1	0.4 (0.1-2.0)	1	0.4 (0.1-2.1)
Astrocytoma III-IV	124	1	6	1.1 (0.4-2.5)	3	0.6 (0.1-1.7)
Controls	874		39		37	

Table 5.7 Leukemia risk in relation to calculated magnetic fields five years before diagnosis

Diagnosis	0-0.09 μT		0.1-0.19 μT		0.2- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	220	1	18	1.3 (0.8-2.3)	20	1.6 (0.9-2.7)
AML	46	1	5	1.8 (0.6-4.4)	5	1.9 (0.6-4.7)
CML	36	1	3	1.3 (0.3-4.1)	6	2.9 (1.0-6.9)
ALL	9	1	0	0.0 (0.0-6.7)	0	0.0 (0.0-5.7)
CLL	93	1	7	1.2 (0.5-2.7)	8	1.5 (0.6-3.2)
Controls	742		46		43	

Brain tumor risk in relation to calculated magnetic fields five years before diagnosis

Diagnosis	0-0.09 μT		0.1-0.19 μT		0.2- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	137	1	16	1.9 (1.0-3.4)	7	0.9 (0.4-1.9)
Astrocytoma I-II	47	1	3	1.0 (0.2-3.1)	2	0.7 (0.1-2.7)
Astrocytoma III-IV	90	1	13	2.3 (1.2-4.5)	5	1.0 (0.3-2.3)
Controls	742		46		43	

Table 5.10 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, only those who have lived 10 years or more at the home near a power line

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	154	1	16	1.2 (0.7-2.3)	18	1.2 (0.7-2.2)
AML	29	1	4	1.6 (0.5-4.6)	5	1.8 (0.6-4.7)
CML	25	1	3	1.4 (0.3-4.5)	6	2.6 (0.9-6.3)
ALL	7	1	0	0.0 (0.0-6.5)	0	0.0 (0.0-5.9)
CLL	71	1	7	1.2 (0.5-2.6)	6	0.9 (0.3-2.1)
Controls	524		44		49	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, only those who have lived 10 years or more at the home near a power line

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	91	1	8	1.0 (0.4-2.2)	7	0.8 (0.3-1.8)
Astrocytoma I-II	29	1	3	1.2 (0.3-3.8)	0	0.0 (0.0-1.2)
Astrocytoma III-IV	62	1	5	1.0 (0.3-2.4)	7	1.2 (0.5-2.7)
Controls	524		44		49	

Table 5.9 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, only those who lived near the power line at the time of diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	162	1	14	1.0 (0.6-1.9)	18	1.2 (0.7-2.1)
AML	34	1	3	1.1 (0.2-3.2)	6	1.9 (0.7-4.5)
CML	28	1	3	1.3 (0.3-4.0)	5	1.9 (0.6-4.8)
ALL	6	1	0	0.0 (0.0-7.9)	0	0.0 (0.0-7.0)
CLL	72	1	7	1.2 (0.5-2.6)	6	0.9 (0.3-2.0)
Controls	538		45		51	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, only those who lived near the power line at the time of diagnosis

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	109	1	9	1.0 (0.4-2.0)	7	0.7 (0.3-1.5)
Astrocytoma I-II	36	1	2	0.7 (0.1-2.4)	1	0.3 (0.0-1.6)
Astrocytoma III-IV	73	1	7	1.1 (0.5-2.5)	6	0.9 (0.3-2.0)
Controls	538		45		51	

Table 5.12 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, only those who lived near the power line at the time of diagnosis and had lived there for 10 years or more

Diagnosis	0-0.09 μT		0.1-0.19 μT		0.2- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	110	1	12	1.2 (0.6-2.3)	13	1.4 (0.7-2.8)
AML	22	1	2	1.0 (0.1-3.8)	4	2.1 (0.6-6.3)
CML	21	1	3	1.5 (0.3-5.0)	4	2.2 (0.6-6.6)
ALL	3	1	0	0.0 (0.0-18.7)	0	0.0 (0.0-20.7)
CLL	48	1	6	1.3 (0.5-3.2)	5	1.2 (0.4-3.2)
Controls	340		32		29	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, only those who lived near the power line at the time of diagnosis and had lived there for 10 years or more

Diagnosis	0-0.09 μT		0.1-0.19 μT		0.2- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	65	1	5	0.8 (0.3-2.1)	6	1.1 (0.4-2.6)
Astrocytoma I-II	21	1	2	1.0 (0.2-3.9)	0	0.0 (0.0-1.9)
Astrocytoma III-IV	44	1	3	0.7 (0.2-2.2)	6	1.6 (0.6-3.9)
Controls	340		32		29	

Table 5.11 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, only those who have lived less than 10 years in the home near a power line

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	124	1	4	0.4 (0.1-1.1)	8	0.8 (0.3-1.6)
AML	29	1	1	0.4 (0.0-2.4)	4	1.6 (0.5-4.6)
CML	20	1	2	1.3 (0.2-4.9)	1	0.6 (0.0-3.4)
ALL	6	1	0	0.0 (0.0-8.4)	1	2.0 (0.1-13.8)
CLL	45	1	1	0.3 (0.0-1.5)	1	0.3 (0.0-1.4)
Controls	400		32		34	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, only those who have lived less than 10 years in the home near a power line

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	101	1	10	1.2 (0.6-2.6)	5	0.6 (0.2-1.4)
Astrocytoma I-II	31	1	0	0.0 (0.0-1.3)	2	0.8 (0.1-2.9)
Astrocytoma III-IV	70	1	10	1.8 (0.8-3.8)	3	0.5 (0.1-1.5)
Controls	400		32		34	

Table 5.14 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, women

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	111	1	4	0.5 (0.2-1.4)	11	1.2 (0.6-2.4)
AML	25	1	1	0.6 (0.0-3.3)	5	2.3 (0.7-6.2)
CML	21	1	2	1.4 (0.2-5.4)	3	1.7 (0.4-5.4)
ALL	4	1	0	0.0 (0.0-16.6)	0	0.0 (0.0-13.4)
CLL	39	1	1	0.4 (0.0-2.0)	2	0.6 (0.1-2.2)
Controls	373		26		32	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, women

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	69	1	9	1.9 (0.8-4.1)	6	1.0 (0.4-2.4)
Astrocytoma I-II	21	1	3	2.0 (0.5-6.8)	2	1.1 (0.2-4.3)
Astrocytoma III-IV	48	1	6	1.8 (0.6-4.4)	4	1.0 (0.3-2.7)
Controls	373		26		32	

Table 5.13 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, men

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	167	1	16	1.1 (0.6-1.9)	15	1.0 (0.5-1.8)
AML	33	1	4	1.3 (0.4-3.7)	4	1.3 (0.4-3.6)
CML	24	1	3	1.4 (0.3-4.3)	4	1.8 (0.5-5.1)
ALL	9	1	0	0.0 (0.0-4.5)	1	1.2 (0.1-7.5)
CLL	77	1	7	1.0 (0.4-2.2)	5	0.7 (0.2-1.7)
Controls	551		50		51	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, men

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	123	1	9	0.8 (0.4-1.6)	6	0.5 (0.2-1.2)
Astrocytoma I-II	39	1	0	0.0 (0.0-0.9)	0	0.0 (0.0-0.9)
Astrocytoma III-IV	84	1	9	1.2 (0.5-2.4)	6	0.8 (0.3-1.8)
Controls	551		50		51	

Table 5.16 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to ages 16-59

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	99	1	3	0.4 (0.1-1.3)	15	1.8 (1.0-3.5)
AML	30	1	2	1.0 (0.2-3.7)	4	1.6 (0.5-4.5)
CML	20	1	0	0.0 (0.0-2.5)	6	3.6 (1.2-9.3)
ALL	9	1	0	0.0 (0.0-6.0)	1	1.1 (0.1-8.5)
CLL	23	1	1	0.6 (0.0-3.6)	3	1.6 (0.4-5.1)
Controls	422		29		35	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to ages 16-59

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	115	1	12	1.5 (0.8-3.1)	5	0.5 (0.2-1.3)
Astrocytoma I-II	42	1	2	0.7 (0.1-2.6)	1	0.3 (0.0-1.6)
Astrocytoma III-IV	73	1	10	2.0 (0.9-4.3)	4	0.7 (0.2-1.8)
Controls	422		29		35	

Table 5.15 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to ages 60-

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	179	1	17	1.0 (0.6-1.8)	11	0.6 (0.3-1.3)
AML	28	1	3	1.1 (0.3-3.6)	5	1.9 (0.6-4.8)
CML	25	1	5	2.1 (0.7-5.6)	1	0.4 (0.0-2.3)
ALL	4	1	0	0.0 (0.0-12.2)	0	0.0 (0.0-11.9)
CLL	93	1	7	0.8 (0.3-1.8)	4	0.4 (0.1-1.2)
Controls	502		47		48	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to ages 60-

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	77	1	6	0.8 (0.3-1.9)	7	1.0 (0.4-2.1)
Astrocytoma I-II	18	1	1	0.6 (0.0-3.4)	1	0.6 (0.0-3.3)
Astrocytoma III-IV	59	1	5	0.9 (0.3-2.2)	6	1.1 (0.4-2.5)
Controls	502		47		48	

Table 5.18 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, Sweden excl. Stockholm county

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	100	1	9	1.0 (0.5-2.7)	9	1.3 (0.6-2.9)
AML	18	1	1	0.6 (0.0-3.8)	3	2.4 (0.5-8.3)
CML	15	1	4	3.1 (0.8-9.6)	4	3.9 (1.0-12.3)
ALL	8	1	0	0.0 (0.0-5.5)	0	0.0 (0.0-7.0)
CLL	38	1	2	0.6 (0.1-2.3)	1	0.4 (0.0-2.2)
Controls	338		29		23	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, Sweden excl. Stockholm county

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	67	1	8	1.4 (0.6-3.1)	5	1.1 (0.4-2.9)
Astrocytoma I-II	18	1	0	0.0 (0.0-2.2)	0	0.0 (0.0-2.8)
Astrocytoma III-IV	49	1	8	1.9 (0.8-4.3)	5	1.5 (0.5-4.0)
Controls	338		29		23	

Table 5.17 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, Stockholm county

Diagnosis	0-0.09 μT		0.1-0.19 μT		0.2- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	178	1	11	0.8 (0.4-1.5)	17	0.9 (0.5-1.6)
AML	40	1	4	1.2 (0.4-3.4)	6	1.5 (0.5-3.4)
CML	30	1	1	0.4 (0.0-2.3)	3	1.0 (0.2-3.0)
ALL	5	1	0	0.0 (0.0-10.5)	1	2.0 (0.1-14.4)
CLL	78	1	6	1.0 (0.4-2.2)	6	0.8 (0.3-1.7)
Controls	586		47		60	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, Stockholm county

Diagnosis	0-0.09 μT		0.1-0.19 μT		0.2- μT	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	125	1	10	1.0 (0.5-2.0)	7	0.5 (0.2-1.2)
Astrocytoma I-II	42	1	3	0.9 (0.2-2.7)	2	0.5 (0.1-1.7)
Astrocytoma III-IV	83	1	7	1.1 (0.4-2.3)	5	0.6 (0.2-1.4)
Controls	586		47		60	

Table 5.20 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to apartment houses

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95%-CI)
Leukemia	158	1	10	0.8 (0.4-1.7)	13	0.9 (0.5-1.6)
AML	36	1	3	1.1 (0.3-3.2)	4	1.2 (0.3-3.2)
CML	25	1	1	0.5 (0.0-2.9)	4	1.7 (0.5-4.8)
ALL	9	1	0	0.0 (0.0-5.3)	1	1.2 (0.1-7.4)
CLL	62	1	5	1.0 (0.4-2.6)	3	0.5 (0.1-1.5)
Controls	518		40		49	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to apartment houses

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	111	1	10	1.2 (0.6-2.4)	3	0.3 (0.1-0.8)
Astrocytoma I-II	36	1	2	0.7 (0.1-2.7)	0	0.0 (0.0-0.9)
Astrocytoma III-IV	75	1	8	1.4 (0.6-3.0)	3	0.4 (0.1-1.3)
Controls	518		40		49	

Table 5.19 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to one family houses

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	120	1	10	0.9 (0.5-1.9)	13	1.3 (0.7-2.5)
AML	22	1	2	1.0 (0.2-4.0)	5	2.7 (0.9-7.3)
CML	20	1	4	2.3 (0.6-6.6)	3	1.8 (0.4-5.8)
ALL	4	1	0	0.0 (0.0-12.9)	0	0.0 (0.0-13.7)
CLL	54	1	3	0.6 (0.1-1.9)	4	0.9 (0.3-2.4)
Controls	406		36		34	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to one family houses

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	81	1	8	1.1 (0.5-2.4)	9	1.3 (0.6-2.8)
Astrocytoma I-II	24	1	1	0.5 (0.0-2.6)	2	1.0 (0.2-3.8)
Astrocytoma III-IV	57	1	7	1.4 (0.5-3.2)	7	1.5 (0.6-3.4)
Controls	406		36		34	

Table 5.22 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to those diagnosed 1975-85

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95%-CI)
Leukemia	185	1	11	0.6 (0.3-1.2)	16	1.0 (0.6-1.9)
AML	44	1	3	0.7 (0.2-2.1)	6	1.6 (0.6-3.8)
CML	26	1	2	0.8 (0.1-3.0)	4	1.8 (0.5-5.2)
ALL	10	1	0	0.0 (0.0-3.7)	1	1.2 (0.1-7.4)
CLL	73	1	5	0.7 (0.2-1.7)	3	0.5 (0.1-1.5)
Controls	599		58		50	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to those diagnosed 1975-85

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	119	1	14	1.2 (0.7-2.2)	8	0.8 (0.3-1.7)
Astrocytoma I-II	35	1	3	0.9 (0.2-2.7)	1	0.3 (0.0-1.9)
Astrocytoma III-IV	84	1	11	1.4 (0.7-2.7)	7	1.0 (0.4-2.2)
Controls	599		58		50	

Table 5.21 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to those diagnosed 1960-74

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	93	1	9	1.7 (0.7-4.0)	10	1.1 (0.5-2.2)
AML	14	1	2	2.6 (0.4-11.0)	3	2.1 (0.5-7.2)
CML	19	1	3	2.9 (0.6-9.8)	3	1.6 (0.4-5.1)
ALL	3	1	0	0.0 (0.0-32.2)	0	0.0 (0.0-17.3)
CLL	43	1	3	1.3 (0.3-4.1)	4	0.9 (0.3-2.5)
Controls	325		18		33	

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, restricted to those diagnosed 1960-74

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	73	1	4	1.0 (0.3-2.9)	4	0.5 (0.2-1.5)
Astrocytoma I-II	25	1	0	0.0 (0.0-2.5)	1	0.4 (0.0-2.2)
Astrocytoma III-IV	48	1	4	1.5 (0.4-4.4)	3	0.6 (0.1-1.9)
Controls	325		18		33	

Table 5.24 Leukemia risk in relation distance

Diagnosis	101- m		51-100 m		0-50 m	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	250	1	50	1.2 (0.8-1.7)	24	1.2 (0.7-2.0)
AML	55	1	12	1.3 (0.7-2.5)	5	1.1 (0.4-2.8)
CML	42	1	7	1.0 (0.4-2.1)	8	2.4 (1.0-5.1)
ALL	12	1	1	0.5 (0.0-2.9)	1	1.0 (0.0-6.2)
CLL	97	1	26	1.6 (1.0-2.5)	8	1.0 (0.5-2.1)
Controls	867		147		69	

Brain tumor risk in relation to distance

Diagnosis	101- m		51-100 m		0-50 m	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	175	1	33	1.1 (0.7-1.7)	14	1.0 (0.6-1.8)
Astrocytoma I-II	55	1	7	0.8 (0.3-1.6)	3	0.7 (0.2-2.0)
Astrocytoma III-IV	120	1	26	1.3 (0.8-2.0)	11	1.2 (0.6-2.2)
Controls	867		147		69	

Table 5.23 Leukemia risk in relation to spot measurements

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Leukemia	96	1	27	1.1 (0.7-1.9)	38	1.2 (0.8-1.9)
AML	23	1	5	0.9 (0.3-2.3)	8	1.1 (0.4-2.4)
CML	21	1	3	0.6 (0.1-1.8)	10	1.5 (0.7-3.2)
ALL	2	1	2	4.1 (0.4-39.3)	2	3.1 (0.3-29.6)
CLL	40	1	13	1.3 (0.7-2.6)	12	0.9 (0.5-1.8)
Controls	374		92		122	

Brain tumor risk in relation to spot measurements

Diagnosis	0-0.09 μ T		0.1-0.19 μ T		0.2- μ T	
	n	RR	n	RR (95% CI)	n	RR (95% CI)
Brain tumor	85	1	25	1.2 (0.7-2.0)	22	0.8 (0.5-1.3)
Astrocytoma I-II	24	1	8	1.4 (0.6-3.0)	3	0.4 (0.1-1.3)
Astrocytoma III-IV	61	1	17	1.1 (0.6-2.0)	19	1.0 (0.5-1.7)
Controls	374		92		122	

Table 5.26 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, matched analysis

Diagnosis	0-0.09 μ T	0.1-0.19 μ T	0.2- μ T
	RR	RR (95% CI)	RR (95% CI)
Leukemia	1	1.0 (0.5-1.8)	1.1 (0.6-1.8)
AML	1	1.5 (0.4-5.3)	2.2 (0.7-6.8)
CML	1	1.3 (0.3-5.1)	3.2 (0.9-11.0)
CLL	1	0.9 (0.4-2.2)	0.6 (0.3-1.6)

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, matched analysis

Diagnosis	0-0.09 μ T	0.1-0.19 μ T	0.2- μ T
	RR	RR (95% CI)	RR (95% CI)
Brain tumor	1	1.0 (0.5-1.8)	0.7 (0.3-1.4)
Astrocytoma I-II	1	0.3 (0.0-1.7)	0.2 (0.1-1.1)
Astrocytoma III-IV	1	1.2 (0.6-2.4)	1.0 (0.4-2.2)

Table 5.25 Leukemia risk in relation to calculated magnetic fields closest in time to diagnosis, adjusted for socioeconomic status

Diagnosis	0-0.09 μ T	0.1-0.19 μ T	0.2- μ T
	RR	RR (95% CI)	RR (95% CI)
Leukemia	1	0.8 (0.4-1.4)	1.2 (0.7-1.9)
AML	1	1.1 (0.4-3.0)	1.8 (0.8-3.9)
CML	1	0.6 (0.1-2.4)	2.1 (0.9-4.8)
ALL	1	0.0*	0.9 (0.1-7.0)*
CLL	1	0.8 (0.4-1.9)	0.7 (0.3-1.8)

* Mantel-Haenszel technique

Brain tumor risk in relation to calculated magnetic fields closest in time to diagnosis, adjusted for socioeconomic status

Diagnosis	0-0.09 μ T	0.1-0.19 μ T	0.2- μ T
	RR	RR (95% CI)	RR (95% CI)
Brain tumor	1	1.2 (0.7-2.0)	0.8 (0.4-1.5)
Astrocytoma I-II	1	0.6 (0.2-2.1)	0.4 (0.1-1.7)
Astrocytoma III-IV	1	1.4 (0.8-2.6)	1.0 (0.5-1.9)

Figure 3.2. Plot of calculated historical field by low-power measurements

Calc. historical
values, μT

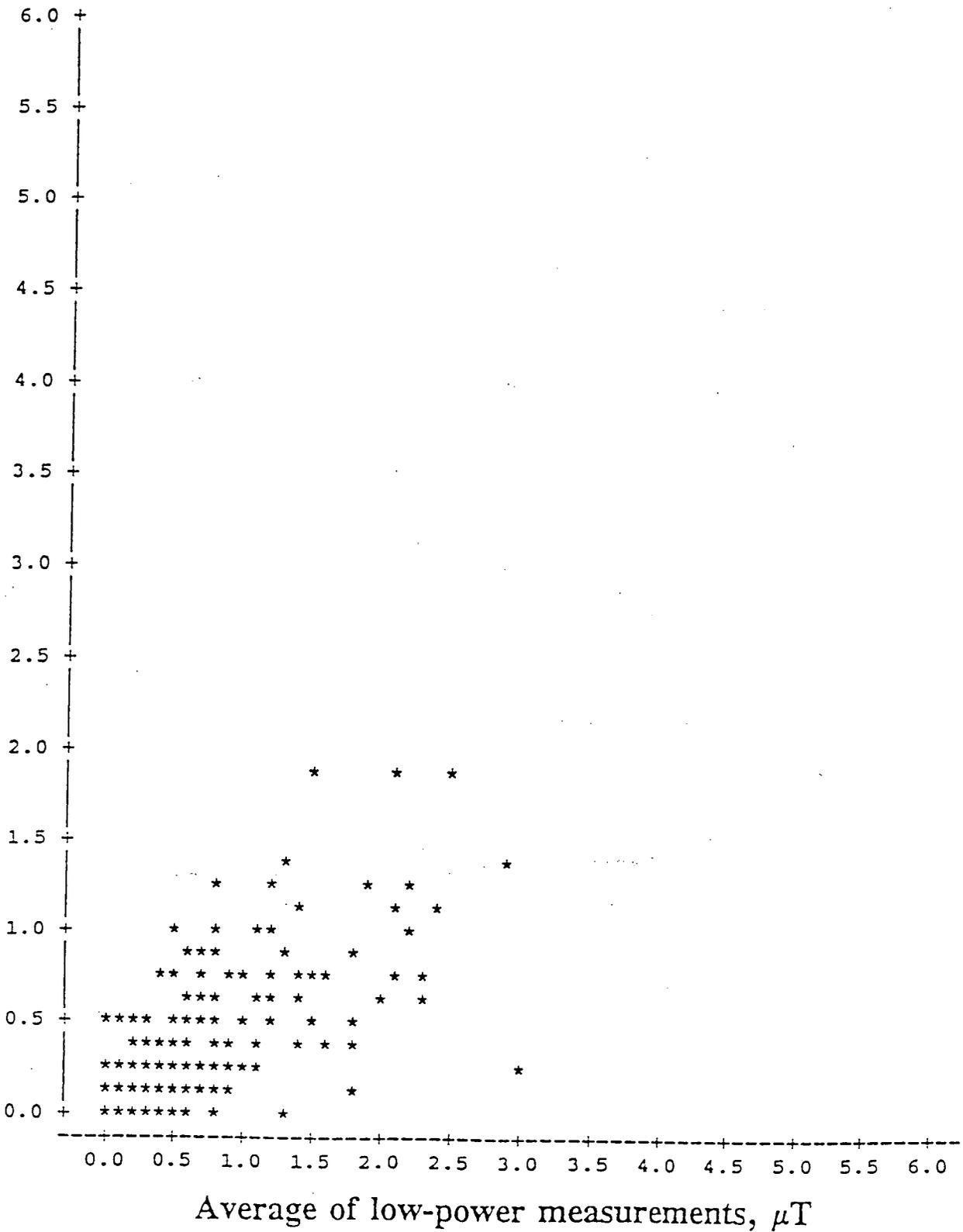


Figure 3.1. Plot of calculated contemporary magnetic field by low-power measurements

Calculated values, μT

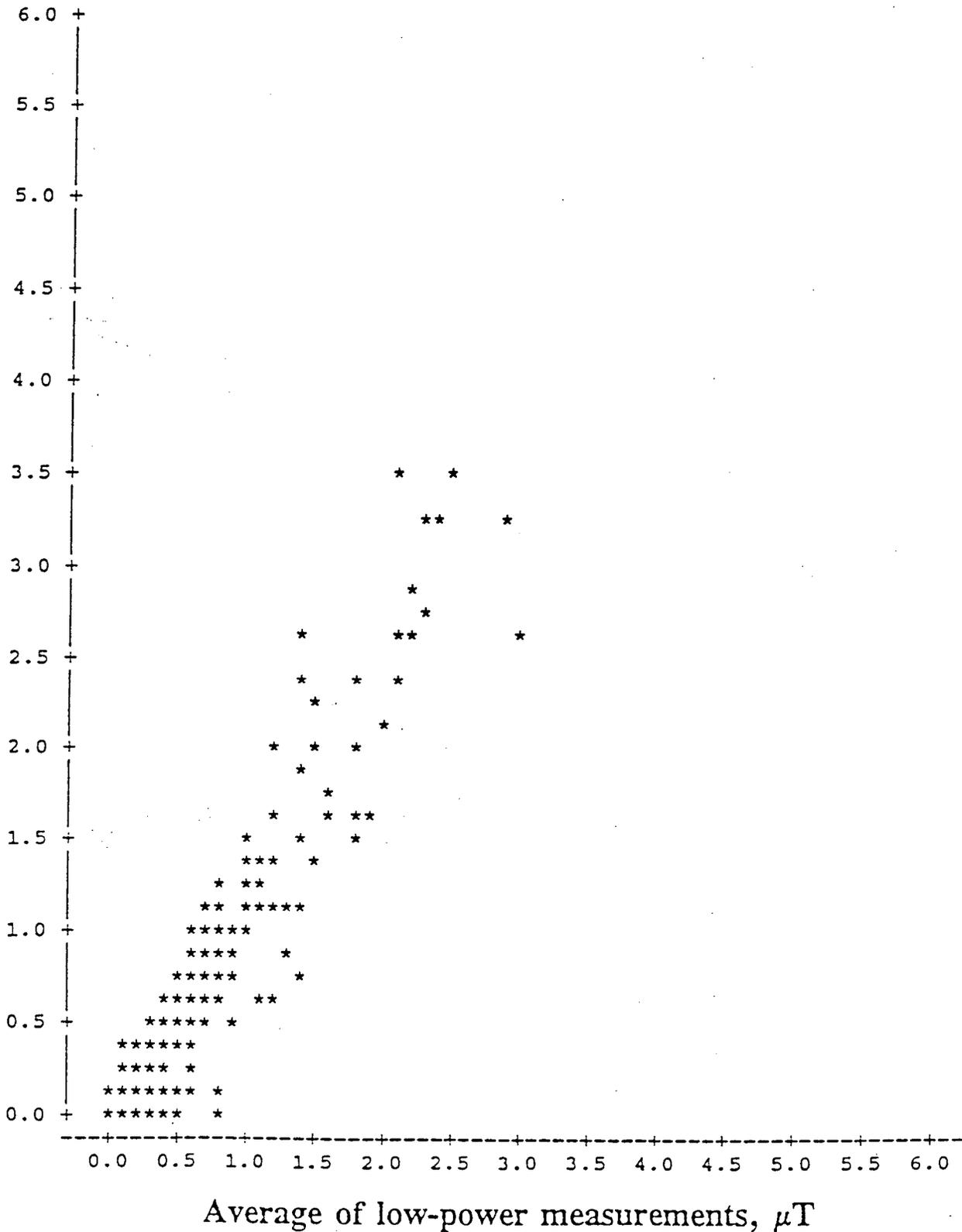
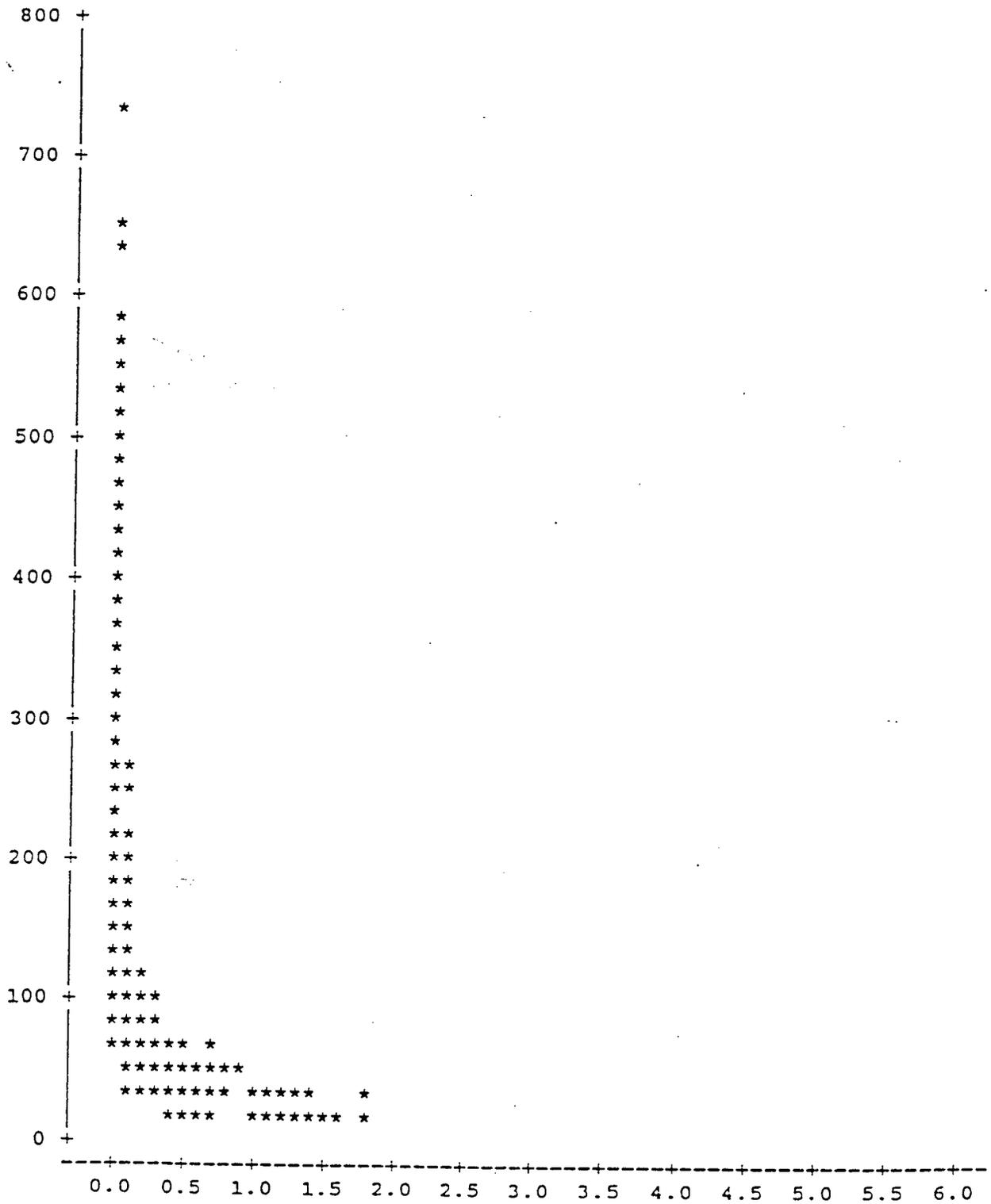


Figure 3.4. Plot of distance to power line by calculated historical field

Distance, m



Calculated historical values, μT

Figure 3.3. Plot of distance to power line by low-power measurements

Distance, m

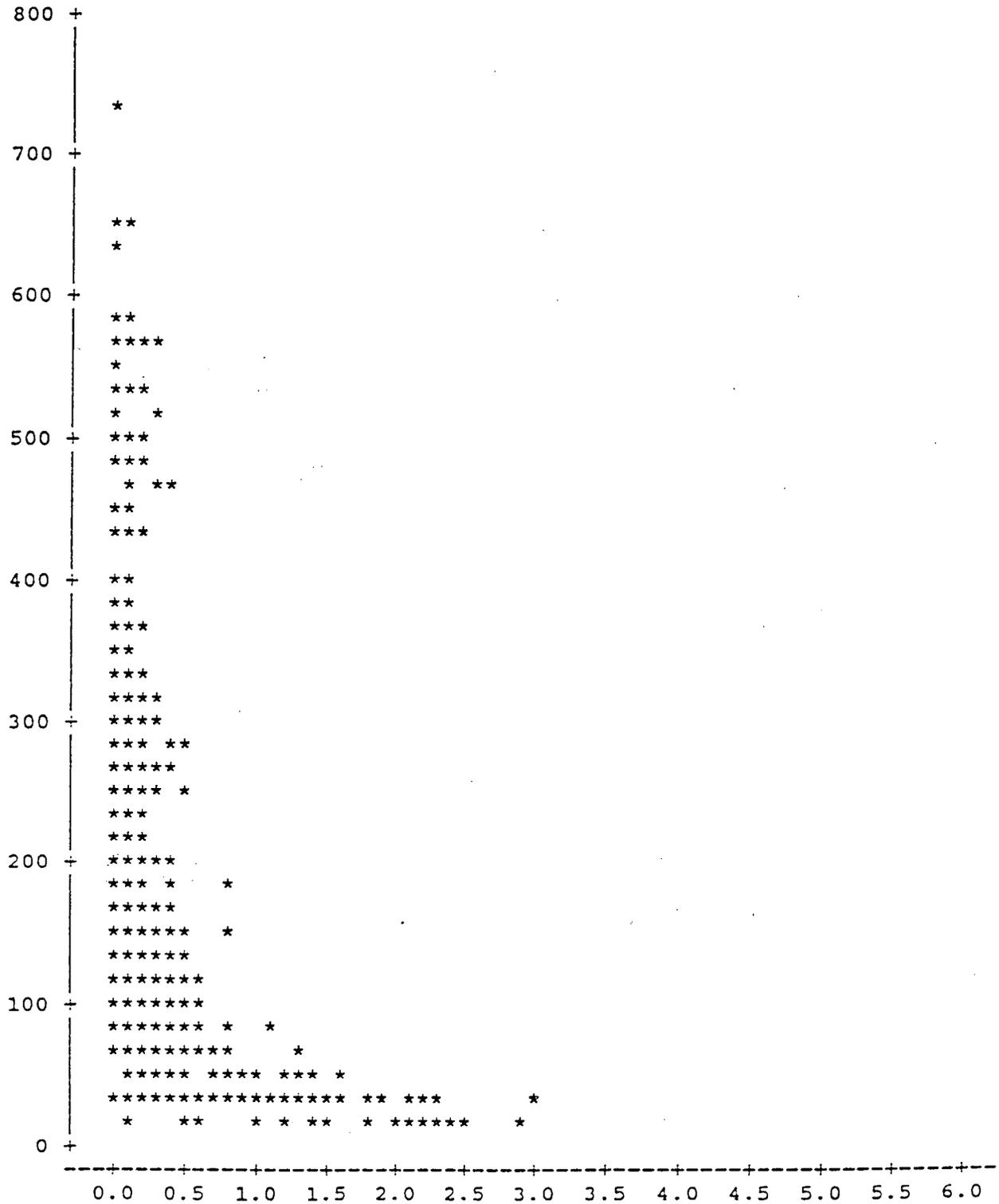


Figure 3.6. Plot of spot measurements by 24-hour measurements, time spent at home

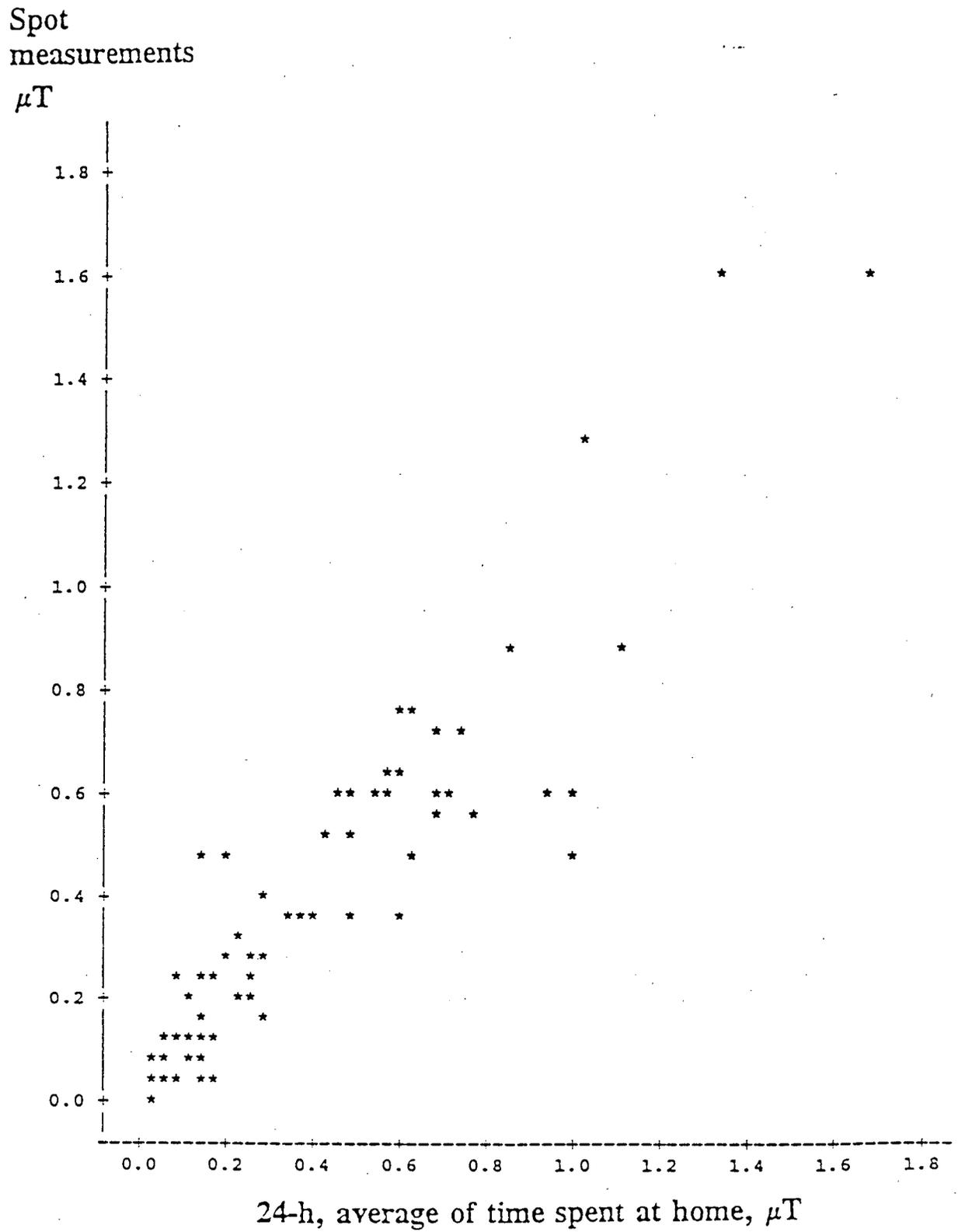


Figure 3.5. Plot of spot measurements by 24-hour measurements

Spot
measurements

μT

