COUNTY OF NEVADA
COMMUNITY DEVELOPMENT AGENCY
PLANNING DEPARTMENT
950 MAIDU AVENUE, SUITE 170, NEVADA CITY, CA 95959-8617
(530) 265-1222 FAX (530) 265-9851 http://mynevadacounty.com

Sean Powers
Community Development Agency Director

Brian Foss
Planning Director

November 29, 2017

TO: Zoning Administrator

FROM: Coleen Shade, Senior Planner

HEARING DATE: November 29, 2017

SUBJECT: PLN17-0073, CUP17-0015 & EIS17-0022 AT&T Mobility dba AT&T Wireless: Submitted Public Comments and Attachments

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Dear Mr. Zoning Administrator,

It has been brought to our attention that the utility easement reflected on the proposed projects site plan has not been procured. Staff recommends adding the following condition of approval A.19:

New Condition of Approval

Prior to issuance of a building permit the applicant shall provide the Nevada County Planning Department documentation of the utility easement in which the electrical power will be transmitted to the project lease-site.

Public Comments Received

After the completion of the project staff report, several public comments have been provided to the Planning Department. You will find the emailed letters and information sent to the County for your review attached. No other new issues have been raised by these comments that are under Nevada County's jurisdiction and haven't been previously addressed by the project specific environmental document and/or conditions of project approval and discussed in the November 29, 2017 staff report. The following is the list of emails received by commenters' name.

Govinda McComb – Property owner 18312 Royal Plum Way, Nevada City
Ryan McVay – Neighbor to the South
Barbara Rivenes – 19556 Burning Bush Road, Nevada City (Grandson's property)
Cynthia Pierce – Property owner immediately adjoining the project parcel
Lisa Reinhardt – Property owner adjacent and south of project parcel
Emily Rivenes – Adjoining property owner
Reinette Senum – Community Member

Johanna Finney - Property Owner 19517 Burning Bush Road, Nevada City (with attachments)

Attachments

- To Members of the California Assembly From Experts Worldwide in Opposition to SB 649
- Neurobehavioral Symptoms near Cell Towers (Color Graph)
- Cell Tower Bomb (Graphic)
- Specific Health Systems and Cell Phone Radiation (Bavaria, Germany)
- Consequences of Microwave RF Exposure (Brazil)
- Significant Decrease of Clinical Symptoms after Mobile Phone Base Station Removal (Japan)
- Article Accepted as a Letter to Editor (France)
- Environmental Epidemiological Study of Cancer Increase in the Municipalities of Hausmannstatten & Vasoldsberg (Austria)
- EMF from RF/Cell Towers (PowerPoint) Sutro Tower
- Impact of Cell Phone Towers on House Prices in Residential Neighborhoods (New Zealand)
- Real Estate Survey, Electromagnetic Health

-CS

Coleen Shade

From: Govinda McComb <govindam@gmail.com>
Sent: Sunday, November 26, 2017 5:00 PM
To: Coleen Shade; Brian Foss
Subject: Regarding Cell Phone Tower on Burning Bush Rd

Dear Brian and Coleen,

I am writing to you today as a resident of Nevada County and very close neighbor to the proposed site of the cell phone tower.
My property and residence is not adjacent to the proposed site, but only one parcel separates us.
I am opposed to the proposed site and have strong concerns about the safety of the tower so close to my home.
I have 3 children who's health and safety are my primary responsibility, and I am a steward of this land and so I care about the health of all the living creatures here.
I moved to this home 8 years ago from the Bay Area, and chose this place because of the remote setting away from city life and all that goes with it, including electromagnetic frequencies.
Even though this is not a heavily populated area, there are many neighbors that will be affected by this project.
With such an abundance of uninhabited land nearby, I encourage you to find an alternative location away from residences.
I hope you will consider my concerns and not continue progress on this project.
Thank you,
Govinda McComb Bryant
18312 Royal Plum Way, Nevada City
415.246.1085

Coleen Shade

From: Ryan McVay <ryanmc888@gmail.com>
Sent: Monday, November 27, 2017 6:35 PM
To: Brian Foss; Coleen Shade
Subject: Please Support Our Neighborhood

Hello Brian and Coleen,

Please deny the application of a Conditional Use Permit for the cell phone tower at 19406 Burning Bush Rd put forth by AT&T, being represented by Shore 2 Shore Wireless Inc. I recently purchased my land just below this location to raise my family including 3 young children. I specificly chose this area because it was free of the RF and distractions that modern society can have on the youth. We study nutrition, teach dance and art localy, as well own a local business. Our family does not own or watch television as well we try to enjoy the outdoors as much as possible. I know there are many families in the area that are also concerned about the close proximity of RF to our homes and I am with them asking please do not allow this for a singular property owner to bring this in to our area for monitary and person gains. Please reply if you would like to receive any links on the dangers of close proximity cell phone towers...

Thank You,

Ryan McVay

Owner / Artist / Designer
Ellu Gallery
(530) 470-3827

Coleen Shade

From: Barbara Rivenes <brivenes@sbcglobal.net>
Sent: Tuesday, November 28, 2017 4:10 PM
To: Coleen Shade
Subject: Comments on Zoning CUP for PLN1717@-0073 - AT&T cell tower on Burning Bush

November 28, 2017

Re: AT&T cell tower placement on 19406 Burning Bush, Nevada City PLN 17-0073

In speaking with my very distressed daughter-in-law at noon today, I was informed of a Zoning Administrator's hearing on placing a cell tower in close proximity to my grandson's (Alec Giron) property at 19556 Burning Bush, Nevada City. The family was unaware of the application and detailed planning regarding the industrialization of his remote, quiet and generally light free environment. Though the warning letter was sent early last week, the timing was very poor – over a long holiday weekend! The unaware neighbors should be granted an extension to properly prepare comments and concerns about the pending application. The probable/possible delay in notification should have been taken into consideration.

The information on the County's website does not correctly describe the location of the cell tower on the 19406 property (Page 12 Tower setbacks - 640-feet from the eastern property line)and could lead a reader to be misinformed about its actual impact on an adjacent property. We were alarmed at the footprint of the installation and the intrusion into this neighborhood of "off-the-grid" inhabitants who chose to live in that particular environment. It's wrong to thrust this industrial development into a neighborhood without benefit of collaboration and discussion among those directly – and even indirectly affected.

What will neighbors be unknowingly and undemocratically be required to do by AT&T – apart from enduring a 900 square foot cleared fenced area with lights and unwelcome activity?

Has the County received complaints about lack of cell service in this area?

The Federal Communications Act of 1996 has determined that health effects of cell towers are not valid reasons for denying zoning for cell tower or antenna. However, aesthetics and property values DO qualify and I believe that the county was in error when it determined that this installation would not be an impact to the adjacent property owners along Burning Bush in that regard. I will repeat my description of this placement having an industrial impact in a previously quiet rural area – a significant blow to the property values. Living next to a cell tower is not high on anyone's list of desirable attributes for property ownership. Alec's parcel contains his house and he does enjoy the ambience of a peaceful and "off-the-grid" experience and has managed to live comfortably producing his own solar electricity.

I would like to urge the Zoning Administrator to re-evaluate the determination of no adverse impact on the neighborhood and suggest that the cell towers be relocated to another location on the proponents 10 acres to place it where it will not impact their neighbors if they decide to move forward with the project.

Thank you for consideration of my comments,

Barbara Rivenes
108 Bridger Ct
Grass Valley, CA 95945
530-477-7502

Coleen Shade

From: Cynthia Pierce <luddite_2@sbcglobal.net>
Sent: Tuesday, November 28, 2017 4:42 PM
To: Coleen Shade; brian.foss@ca.nevada.ca.us
Subject: Burning Bush cell tower permit proposal

To Colleen Shade and Brian Foss

Re: File No. PLN 17-0073, CUP 17-0015, EIS 17-0022

My name is Cynthia Pierce and I am writing in regard to the proposed cell tower at 19406 Burning Bush. I have lived in Nevada City since 1979 and I have owned the parcel immediately adjoining 19406 since 1990. I initially purchased it not as an investment but for its remoteness and natural beauty, by which I mean its trees and plants and birds and animals, its lack of ambient light and noise, its views in many directions. Since purchase I have also thought often--and still do-- of building a small structure on it and of living there in my retirement.

Over the years I have also owned two other parcels in the immediate area of 19406, another one immediately adjoining it, 19517 Burning Bush (1990 to 2000) which I "re-developed" with a small house, and the other, 19556 Burning Bush (1999-2005) which already had a small house on it. Although I have only held close the prospect of living on Burning Bush, I have over the many years spent a fair amount of time there.

I was alarmed last week to have received in the mail the proposal for a cell tower on the property immediately adjoining mine, in fact within 30 feet of the property line I share with 19406. I was also distressed to see the very short window period for comments, especially for a proposal of such consequence to its many neighbors. It is for these reasons I have undertaken what must perforce be a quick study of the cell tower "issue" generally and of its import to me.

With this letter I am asking first and foremost that any action on this be rescheduled to a later time to permit public review of all applicable issues and documents and to allow the public to make additional comments. Absent that assurance of rescheduling, I am writing a few brief comments, the thrust of which asks that you deny the permit.

My understanding is that you are bound by federal regulations from considering the environmental effects of RF radiation and while I know that introducing that consideration would likely devolve into a debate about regulatory authority and current understanding of the human impacts of RF radiation, I also know that the potential health effects inform some of the other arguments/concerns about the cell tower proposal.

The threat to property values is perhaps foremost among them. As the property owner of land which is within 30 feet of said tower enclosure I not only feel the loss of the land VALUE to me as a potential living site due to health, aesthetic, noise, and other reasons, but its loss of value if I were to sell it. The studies on depreciating land values for properties proximate to cell towers are convincing and are further evidence of the self-same concerns and perceptions of potential buyers.

The tower as currently placed will be in my line of vision each time I approach my property, as it will be for all users of the Burning Bush, and its massive and anomalous appearance for me is more of an annoyance at an unlovely structure and an unwelcome reminder of its potential harm than it is a serious irritation as a "visual pollutant".

While the document addresses the noise levels of the background generator testing and operation, it fails to notify the nearby owners of the noise from the on site air conditioning unit which will run if not continuously throughout the year, then certainly during the summer months. The document does say it will meet county noise standards, which does not

give this owner comfort since apparently leaf blowers and OHVs and chainsaws operate under those same standards. Currently, there is little to no industrial noise throughout the year.

While the document (p. 49) requires that the permittee protect the structure for 100 feet of fuel treatment or to the property line, it does not address whether adjacent property owners will have to create the additional defensible space beyond the property line if it is under 100 ft., which this one is.

Finally, if neither an extension of hearing nor a denial of the permit is granted, I would like consideration to be given to placing the tower on another location on the owner's property where the impacts would be born by the owner.

Thank you for your attention to this. Of course, I am open to being contacted.

Sincerely,

Cynthia Pierce

Sent from my iPad

Coleen Shade

From: Lisa Reinhardt <lisalureinhardt@gmail.com>
Sent: Tuesday, November 28, 2017 4:47 PM
To: Coleen Shade
Subject: Fwd: Burning Bush Cell Tower

Sent from my iPhone

Begin forwarded message:

From: Lisa Reinhardt <lisalureinhardt@gmail.com>
Date: November 28, 2017 at 3:53:53 PM PST
To: brian.foss@co.nevada.ca.us, colleen.shade@co.nevada.ca.us
Subject: Burning Bush Cell Tower

To Whom It May Concern,

I am writing to express my concerns and opposition to the proposed 130-foot cell tower at Burning Bush Road.

My husband and I bought our property in the Royal Plum area seventeen years ago and built our house, well aware that many of our neighbors lived off-grid with solar (we have grid-tied solar) and valued the peaceful quiet afforded by the surrounding wilderness. We chose this area because it suited our love of the outdoors and we knew it would remain quiet and fairly undeveloped. And, while certain advances have happened and been welcomed like the paving of Cooper Road, the placement of a cell tower on the property directly north of ours feels shockingly out of place amidst our quiet and nature-loving neighborhood. It has come to our awareness this past week after several neighbors also received the county's zoning letter that our fellow-neighbors are also very much concerned.

I have read the full proposed report and while it covers and serves to answer possible problematic areas of concern, the one that is least covered is health concerns. I would say that this is the area of *most* concern to the neighborhood. There is no doubt that there are different lenses to look through when evaluating potential health threats. On the one side the FCC along with all the cell companies stand by their claim that RF energy has mostly no adverse effects. On the other side you have independent scientific studies and tons of empirical evidence to show that again and again, individuals and communities have been affected by everything from altered sleep and serotonin levels to cancer. The bottom line is that there are still too many unanswered questions and grey areas when it comes to the relative safety of living in close proximity to a cell tower. Therefore, my husband and I must err on the side of caution on behalf of our daughter, ourselves, and ALL of our neighbors. We have several families in this neighborhood and we are greatly concerned for all the children who are more sensitive to environmental factors while still developing. If there is any reason to err on the side of caution it should be to protect our children from what could be potentially destructive or disastrous to their developing bodies.

In our opinion, while many of us would certainly appreciate better cell and internet service, there is absolutely no reason to place a cell tower in a populated neighborhood. There has got to be a better, safer location for this proposed tower.

We understand from our neighbors Pamela and Rob that they pursued having a tower so that they could have power brought to their property. We have let them know that while we don't feel comfortable with a cell tower and we will also support the majority of fellow neighbors who don't want a tower nearby, we would be very

happy to work with them in their goal to bring power to their home. We are happy to grant an easement for power access and explore options with them that may make it more affordable.

We hope that the Zoning Administrators will hear our plea and agree that one homeowner's desire for PG&E power is absolutely no justification for a cell tower in a residential neighborhood where nobody wants it. Let us instead, come together as a unified community and make decisions that will benefit the greater whole and hopefully satisfy everyones' needs.

Thank you for your time.

Sincerely,

Lisa Reinhardt

Coleen Shade

From: Emily Rivenes <emily.rivenes@att.net>
Sent: Tuesday, November 28, 2017 4:54 PM
To: Coleen Shade; Brian Foss
Subject: Conditional Use Permit PLN1717@-0073

Dear Brian & Coleen:

I am a co-owner of a parcel on Burning Bush just a few hundred feet from the proposed project site. I am very opposed, and quite concerned about the potential approval of the project and ensuing installation a cell phone tower in the area.

As a real estate agent, I'm acutely aware of the impact perceptions have on the desirability of a property. In my professional opinion, I'm quite sure that the installation of a cell tower within even a few miles, let alone next door, would have a dramatic and negative impact on the marketability of nearby properties. Many buyers would downright refuse to live next to a tower, and this alone reduces the pool of potential buyers thereby devaluing the property. Whether or not health concerns are a real risk is not the issue in the case of price devaluation, it's only the perception that will determine whether or not a buyer will demand a price reduction to compensate for the perceived threat, or even be willing to consider buying in a nearby location. Additionally, with the increased risk of fire in an already extremely high danger zone, and the recent decline of insurance carriers willing to write policies in the area, nearby property owners could quite probably come up against having their hazard insurance policies cancelled and become unable to obtain new policies for hazard insurance. In this case our properties would be worth practically nothing.

Perception is not only a consideration in the property valuation, but in other factors including health effects. I may not know for a fact that proximity to cell towers have a negative health impact, but I am certainly not willing to live next door to one. Nor am I permitting my son and potential grandchildren to be the Guinea pigs in this experiment of new technology. If there is any chance that there could be such severe impacts, this tower should not be installed.

Much of the reason we bought property in this area was to live off-grid. It's hard to explain the peacefulness of the top of Burning Bush, but when you're there it's as if there's actually peace in the world and you're in the middle of it. I'm quite upset that one individual neighbor has decided upon her own, and for solely her own financial benefit, that the rest of the neighborhood will have to deal with the noise of installation, the ongoing sound of generators running for multiple hours per week every week for 20+ years. There's also the possibility that it will be lighting up the night sky, and who knows what other intrusions the cell phone companies will include in their contracts. Not to mention imposing potentially very serious health hazards upon her neighbors.

Please do not approve this project. As residents of the neighborhood, we should have a say in determining what conditional uses we would permit. This must be the reason that the neighbors have to be notified and why there is a public hearing being held on the subject.

Also, please note my displeasure that the notification letter was sent just in time to arrive prior to a 4 day holiday weekend. The neighbors have had only had 2-3 business days notice to look into this very complex matter. We have had no time to do the research and have the discussions we need in order to come appropriately prepared to either support or oppose this project. As a neighborhood, we at least need the chance to get together and talk amongst ourselves and the property owner. Please at least postpone the verdict until we've had a fair amount of time to gather our thoughts.

Thank you for your consideration.
Emily

Emily Rivenes, MS, CPA, CFP ®
CA Real Estate License # 01791107
Nevada County Properties
431 Broad Street,
Nevada City, CA 95959
Emily.rivenes@att.net
(530) 913-7316 (cell)
(530) 265-3316 (home office)

Date: 11/29/17
From Reinette Senum, 662 East Broad St., Nevada City, CA 95959
To: Nevada County Zoning Administrator Brian Foss
(brian.foss@co.nevada.ca.us).and Senior Planner Coleen Shade (coleen.shade@co.nevada.ca.us).
Regarding: A conditional Use Permit proposing the construction/installation of an unmanned 130-foot tall mono-pine telecommunication tower and equipment facility at 19406 Burning Bush Rd put forth by AT&T, being represented by Shore 2 Shore Wireless Inc..
File Nos. PLN17-0073, CUP17-0015, EIS17-0022. Applicant: AT&T Mobility dba AT&T Wireless. Owner: Pamela Swartz

Dear Mr. Brian Foss & Ms. Coleen Shade,

Myself and many other community members feel it imperative to warn the property owners currently considering the cell tower installations on 19406 Burning Bush Rd, Nevada City. We believe AT&T may not have been completely forthcoming in explaining the hidden risks in this cell tower installation.

We want to ensure that they know that in 2012 global insurers, such as Lloyd's of London, began excluding RF Exposure Coverage based upon their forecast of substantial future Radio Frequency injury claims.

Subsequently, the telecom industry giants, such as Verizon, AT&T, and Comcast, responded to this announcement by warning their investors; "*"Unfavorable litigation... could require us to pay significant amounts" and that "We are subject to a number of lawsuits both in the United States and in foreign countries..."*

This is why we are here today: Because of this incredible liability, the telecom industry has cleverly externalized their risks onto the property owner. The County of Nevada, as well, prefers this scenario because this too clears them of any wrongdoing in case of property or RF injury claims, including loss of property values, a trend that has now become

synonymous with cell towers.

In spite of what AT&T is telling the applicants, they will be required to accept two additional co-locations from additional wireless companies; meaning the power density will only *increase* three-fold over time.

They are also vulnerable to lawsuit in case of damage caused by these cell towers' 54 gallon diesel tank during storm or fire.

Again, in these cases they will not be insured.

They may also like to know that it is very unlikely they will be able to opt-out after five years in spite of what the telecom reps tell them. The telecom industry rarely invests in equipment that they don't plan on utilizing for at least 20-25 years. They need to read the fine print.

Lastly, your decision as a county is forcing all surrounding neighbors to bear all the risk with very little gain beyond an increased signal. Are you, as county officials, truly comfortable with this?

Ultimately, for their own sake, we hope they will understand that whatever gain they make monetarily today they will lose in litigation tomorrow.

By consenting to these cell towers they consent to massive liability. Do you think this is really what they want to sign up for?

Because of the burden of liability and risk upon the property owner, we kindly request that the county think twice before approving this application for the sake of the property owner.

Most Sincerely,

Reinette Senum
662 East Broad St.,
Nevada City, CA 95959

Coleen Shade

From:	Johanna Finney <johannafinney@gmail.com>
Sent:	Tuesday, November 28, 2017 5:48 PM
To:	Coleen Shade; Brian Foss
Subject:	Public Statement re: Public Hearing for File No. PLN17-0073, CUP17-0015, EIS17-0022
Attachments:	Public Statement by Johanna Finney PLN17-0073.pdf; 2017-0905-SB649-Experts-Worldwide-Opposition-Letter.pdf; Impact-of-Cell-Towers-on-House-Prices.pdf; Real Estate Survey.pdf; SutroTowerCellTowerEMF2.ppt; Property-devaluation-cell-towers.pdf; Austrian Cell Tower Study copy.pdf; SantiniLetter.pdf; Japanese-Cell Tower Study-2014-Significant-Decrease-of-Clinical-Symptoms-after-Mobile-Phone-Base-Station-Removal.pdf; Bavaria_Cell_tower_study.pdf; Belo Horizonte, Brazil Cell Tower.pdf; Sun City Bomb Blast.jpeg; Santini Color Slide.jpeg

Please enter all attachments into the record and confirm receipt.

Date: 11/28/17

From: Johanna Finney, owner of residence 19517 Burning Bush Road, Nevada City, CA 95959

To: Nevada County Zoning Administrator Brian Foss (brian.foss@co.nevada.ca.us).and Senior Planner Coleen Shade (coleen.shade@co.nevada.ca.us).

Regarding: A conditional Use Permit proposing the construction/installation of an unmanned 130-foot tall mono-pine telecommunication tower and equipment facility at 19406 Burning Bush Rd put forth by AT&T, being represented by Shore 2 Shore Wireless Inc. to be held on Wed. 11/29 at 2 at 950 Maidu Ave in Board Chambers of Eric Rood Admin Center. File No. PLN17-0073, CUP17-0015, EIS17-0022. Applicant: AT&T Mobility dba AT&T Wireless. Owner: Pamela Swartz

My name is Johanna Finney and my residence is the nearest to this proposed mono-tower site, 450 feet away. The location is 19517 Burning Bush Road, Nevada City, CA.

I am opposed to the construction of the tower and am asking the Zoning Authority to deny the application based on the following:

1. **Property Devaluation:** There have been studies showing that buyers do not want to buy property located near a tower, and the selling price of the property drops significantly if the property is

sold. In one survey completed by the National Institute for Science, Law & Public Policy (NISLAPP), 1000 buyers were surveyed and, "An overwhelming 94 percent of home buyers and renters surveyed by NISLAPP say they are less interested and would pay less for a property located near a cell tower or antenna." Another study combined a survey with post-sale pricing data, that the sale price dropped an average of 21%. Both of these studies and other references as to property devaluation are attached to this statement to be entered into the record of public hearing for this matter.

1. https://takebackyourpower.net/real-estate-survey-results-cellgrid-towers-impact-propertys-desirability/
2. https://www.emfanalysis.com/property-values-declining-cell-towers/ -

As the nearest property owner, just 450 feet from this proposed tower, this is a grave issue of concern to me. I feel it threatens the value of my asset and the property value of neighboring properties. I'm concerned that this issue may open Pamela Swartz to liability by sellers in the area should devaluation occur or difficulty selling the property ensue due to the proximity of the tower. And if she wants to sell her property, she may also have to encounter a loss in property value or increased difficulty finding a buyer.

> I am asking the Nevada County Zoning Authority today if Ms. Swartz was given this information by AT&T, Shore2Shore, and the County about this financial risk? If not, I put forth that they have been misleading. **In fact, I am initiating a California Public Records Act request that any and all emails, letters and telephone notes from Shore2Shore and/or ATT to the Nevada County Planning Commission, Zoning Authority and/or any other County Official be released immediately.**
>
> **I also require that I be provided with the printed policy that the 7-day notice of public hearing is all that is required when it comes to zoning for cell phone towers.** Note, that this letter was mailed on 11/17/17, a Friday. I and other adjacent property holders only received that letter in the afternoon of Tuesday 11/21. I had one day to speak with your office, Wednesday 11/22, before your office was closed for two days due to Thanksgiving. When I asked Ms. Shade on 11/22 if she would be available to talk on Monday 11/27, she said yes. I left a message for her at 9 am on Monday 11/27. She did not return my call until Tuesday 11/28 at 8:24 am. So essentially, I have had only TWO days to communicate with your office on an issue that could impact our entire neighborhood for decades. Is that the policy of your office, to provide such limited time to communicate on these issues? And why is it the policy of this office not to post something in the community affected. The fact that not one of my neighbors knew about this application or hearing is an appalling and dramatic failure of your county office to represent and serve us.

2. **Aesthetics** – In the Impact Discussion regarding Aesthetics, the Staff Report states that the Aesthetics will have less than significant impact. I completely disagree, and I put forth that the bottom photo of Figure 4 on page 8 of the ZA Staff Report provided as a simulation of what the tower will look like from Burning Bush Road is misleading, not accurate, is deceptive and not representative of the view. How is it that the simulated photo shows a mono-tower that is at the same height as the surrounding trees, when in fact, on page 7 of the Staff Comment in the ZA Staff Report it states that the "the top of the proposed 130-foot mono-pine would be at approximately 3,493 feet elevation, and tree-top elevation of the surrounding cedars and pines ranges from 3,428 to 3,464 (and adjacent trees range from 65' to 100'." I ask that this application be denied on the basis of misleading and deceptive information from the applicant. The same is true regarding Figure 5. The simulation shows a tower at the same height as the surrounding trees. This will have Significant Impact on Aesthetics

when the top of the tower can be very easily seen coming out 30 to 60 feet higher than the surrounding trees.

I am submitting at the hearing a photo taken from my deck. Looking toward the proposed site, I can see the end of the drive way of the proposed site. When I look above that, I will clearly see the tower above the trees. This destroys my view. I bought this property, as many others did in the community with a desire to be in nature. Now, imagine what it's like for me, who purchased this home to be surrounded by REAL trees, not fake mono-towers that extend 30-60 feet beyond the tree line, to now have an unwanted cell tower installed within my view when I drive up the road, walk out of my home or out onto my deck? This tower will destroy my view of nature, devalue my property, and I am asking the Zoning Authority to deny this application based on false finding of Less Than Significant Impact on Aesthetics in the existing setting. In fact, the proposed project would a) have significant Impact and result in demonstrable, negative, aesthetic effects on scenic vistas and views open to the public, and c) Substantially degrade the existing visual character and quality of the site and its surroundings. Deny this application based on the Federal Communications Act of 1996 mandating the County with the authority deny this permit application for a cell tower based on aesthetics.

3. **Misleading or Omitted Information**: In my discussion with Pamela Swartz on both Tuesday Nov. 21, 2017 and again Monday 11/27/17, she expressed to me that she is under the impression that, as the property owner leasing to AT&T, she has the authority and ability to decide whether another telecommunications company can come in to fill the two co-located spots that are written into the plan. I have urged her to check that thoroughly, because as I understood it from my discussion last week on Wednesday, Nov. 22,, 2017 with the Zoning Authority's Senior Planner Coleen Shade, those companies will go in once the conditional use permit and building permits are approved at the discretion of AT&T. If this information was not clear to Ms. Swartz, then I am asking for a denial on the permit based on withholding or misleading information.

In addition, Ms. Swartz was under the impression that at the five-year mark of the contract that if she, the property owner, wants AT&T to remove the tower, that she has that authority. It is my understanding that typically the decision to renew or decline renewal of the 5-year lease is done at the sole discretion of AT&T. And if this contract is a typical 5-year contract that can get renewed 5 times – Ms. Swartz is facing a 25-year lease that they she cannot stop. Again, if this information was not clearly presented to Ms. Swartz, then I am asking for a denial based on withholding or misleading information.

4. **Liability:** Was it shared by the County, Shore2Shore, or AT&T with Ms. Swartz that global telecommunications industry underwriters such as Lloyd's of London are excluding radio frequency injury coverage? While RF levels of safety are not at issue here for this discussion, I am inquiring as to whether disclosure was made in this application and contract with Ms. Swartz of the incredible potential liability risk to the lease holder. The ramifications of insurance firms excluding RF coverage are considerable.

Excerpts from statements in AT&T 2016 Annual Report that indicate they are informing their shareholders that they may incur financial losses related to electromagnetic fields: ""Unfavorable litigation or governmental investigation results could require us to pay significant amounts or lead to onerous operating procedures… We are subject to a number of lawsuits both in the United States and in foreign countries, including, at any particular time, claims relating to antitrust; patent infringement; wage and hour; personal injury; customer privacy violations; regulatory proceedings; and selling and collection practices. We also spend substantial resources complying with various government standards, which may entail related investigations and litigation. In the wireless area,

we also face current and potential litigation relating to alleged adverse health effects on customers or employees who use such technologies including, for example, wireless devices. We may incur significant expenses defending such suits or government charges and may be required to pay amounts or otherwise change our operations in ways that could materially adversely affect our operations or financial results."

www.att.com/Investor/ATT_Annual/2016/downloads/att_ar2016_completeannualreport.pdf

In addition, Verizon's **ANNUAL REPORT also Warns Investors:**

"We are subject to a significant amount of litigation, which could require us to pay significant damages or settlements. ...our wireless business also faces personal injury and consumer class action lawsuits relating to alleged health effects of wireless phones or radio frequency transmitters, and class action lawsuits that challenge marketing practices and disclosures relating to alleged adverse health effects of handheld wireless phones. We may incur significant expenses in defending these lawsuits. In addition, we may be required to pay significant awards or settlements."

verizon.api.edgaronline.com/EFX_dll/EdgarPro.dll?FetchFilingConvPDF1?SessionID=Do59qmn_u0wVg_T&ID=11871260

The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, and has been the subject of substantial study by the scientific community in recent years. AT&T cannot guarantee that claims relating to radio frequency emissions will not arise on or around the proposed site. If a connection between radio frequency emissions and possible negative health effects is established, these companies currently do not maintain any significant insurance with respect to these matters.

Was this potential lease holder, Ms. Swartz, given this information? Without adequate insurance, the risk to the property owners far outweighs the lease revenue they receive. A single uninsured RF injury claim can wipe out years of lease revenue and expose the property owner to expensive litigation costs. **Brian Foss, I am asking you to deny the application based on non-disclosure of liability risks.**

5. **Health Risks:** While it is understood that the county cannot speak to the safety levels of RF set forth by the FCC, I am attaching multiple studies that show that indeed harmful effects are occurring at lower levels than what is approved. This is a HUGE concern of mine and my surrounding neighbors. AT&T, Pamela Swartz and Nevada County are putting us all at increased risk for multiple health risks and potential death, and opening Ms. Swartz to liability claims.

Submitted by Johanna Finney 11/28/17 via email to Coleen Shade and Brian Foss.

TO MEMBERS OF THE CALIFORNIA ASSEMBLY FROM EXPERTS WORLDWIDE IN OPPOSITION TO SB 649

September 5, 2017

Honorable Assemblymembers:

Within a matter of days SB 649 will come before the Assembly for a vote. This bill denies citizens and local governments the right to a voice as to where 50,000 or more new cell towers, spaced every two to ten homes, will soon be placed. Telecom will be erecting towers in the rights-of-way, and placing them on utility poles and lampposts in front of our homes, schools, places of worship and businesses. There will be no escaping the cell towers or the radiation emitted from them. SB 649 fails to mandate monitoring of radiation levels from these cell towers at a time when the FCC is closing their regional monitoring offices. A failure to monitor is a failure to regulate.

SB 649 has flown through the Senate and Assembly committees thus far despite opposition from the cities of Los Angeles, San Francisco, and San Jose as well as 294 other cities, the Teamsters, AARP, Environmental Working Group, Environmental Health Trust, Communications Workers of America, the League of Cities, California Brain Tumor Association, a host of environmental and justice groups, and leaders of 47 California counties.

We are asking you to vote NO on SB 649. There is a substantial body of evidence that this technology is harmful to humans and the environment. The 5G millimeter wave is known to heat the eyes, skin and testes, and the ubiquitous placement of these towers will expose California's population 24/7. Of particular concern are the most vulnerable among us -- the unborn, children, the infirm, the elderly and the disabled. It is also expected that populations of bees and birds will drastically decline.

Ironically, the strongest among us, the firefighters, received an exemption from SB 649. After years of their stations being targeted for cell tower placement, SPECT brain scan testing among a group of California firefighters revealed abnormalities that included cognitive impairment. This translated to firefighters occasionally getting lost while driving their emergency equipment through the streets in the same town they grew up in. Infertility and miscarriages plagued the department. Perhaps most shocking of all, the cell tower near the station was measured at 1/1000th of the allowed limit set by the FCC.

We support the fire station exemption of SB 649. If the firefighters are impaired, we are all at risk. Yet this exemption protects the strongest of the strong and forces the most vulnerable among us to live with the greatest exposure. We find that unacceptable. We also find the health risks both real and deeply concerning.

In May 2016 the National Toxicology Program, part of the U.S. National Institutes of Health, released partial results of a $25,000,000 study on laboratory animals which showed a link between the RF (wireless) radiation and two types of cancer, prompting the American Cancer Society's chief medical officer to note that the results "mark a paradigm shift in our understanding of radiation and cancer risk.'' The NTP study also found DNA breakage in brain cells, confirming multiples studies dating back to 1994. The NTP study follows the 2011 classification by IARC, the World Health Organization's cancer committee, of radiofrequency electromagnetic fields -- including cell tower radiation -- as possibly carcinogenic to humans. This puts RF radiation in the same category as DDT.

Our children are not just our progeny but the future of our state and our country. Keeping them safe must be a priority. Our homes must remain our sanctuaries. We currently have the option to turn wireless off at night, or to not use it at all. With SB 649 there is no "off" switch. Not only will SB 649 tie our hands as parents and private citizens, but this bill usurps ALL local control.

In a time that begs for strong compassionate leaders, we are turning to you to reject this bill, and work with independent health and technology experts from around the world to devise a safer solution so that we can stay connected yet protected.

Respectfully,

Lennart Hardell, MD, PhD
Senior Consultant
Department of Oncology
University Hospital
Orebro, Sweden

Frank Clegg
CEO, Canadians for Safe Technology (C4ST), Oakville, Canada
Former President, Microsoft Canada

Cindy Sage
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Beatrice A. Golomb, MD, PhD
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Ellie Marks, Director
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Andrew A. Marino, PhD, JD
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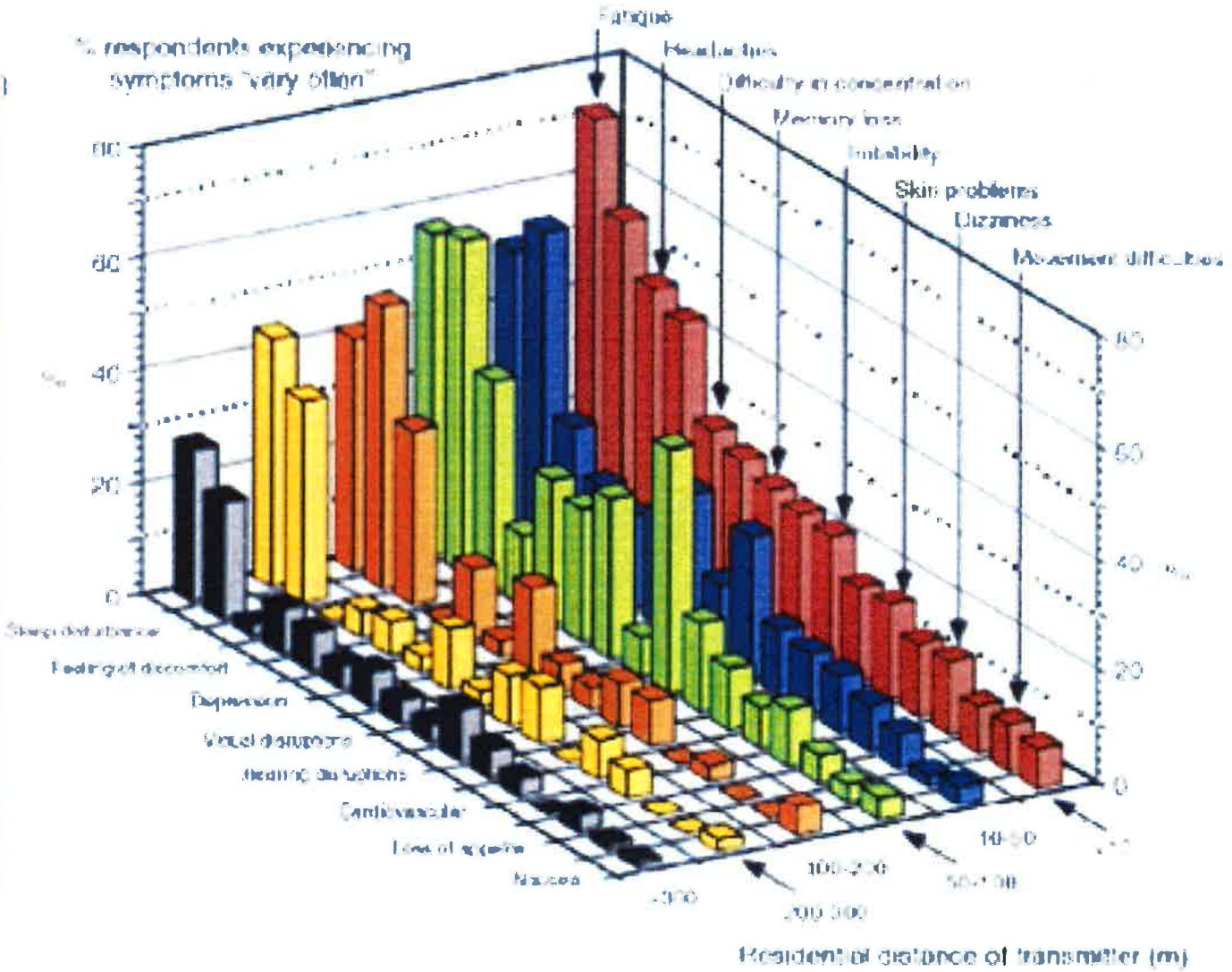
Professor Emeritus of Biochemistry and Basic Medical Sciences
Washington State University
Pullman, Washington

Neurobehavioral Symptoms near Cell Towers

Rapid aging syndrome (RAS)
Electro-Hyper-Sensitivity (EHS)

1. Fatigue
2. Sleep disturbance
3. Headaches
4. Feeling of discomfort
5. Difficulty concentrating
6. Depression
7. Memory loss
8. Visual disruptions
9. Irritability
10. Hearing disruptions
11. Skin problems
12. Cardiovascular
13. Dizziness
14. Loss of appetite
15. Movement difficulties
16. Nausea



Work of Santini et al (France): Pathol Biol. 2002;50:S369–73.


300
500

Specific Health Symptoms and Cell Phone Radiation in Selbitz (Bavaria, Germany)— Evidence of a Dose-Response Relationship

Horst Eger and Manfred Jahn

In January 2009 the administration of the Bavarian Municipality of Selbitz gathered relevant data from 251 residents as part of a health survey. Subsequently, the data were assessed based on the exposure levels of cell phone radiation.
In a next step, the exposure levels based on residential location and available RF measurements of local cell phone radiation levels were used to classify participants into exposure groups.
The mean radiation exposure level of the highest exposure group in Selbitz (1.2 V/m) was substantially higher than that of the study population in the QUEBEB study (1) of the German Mobile Phone Programme (mean value 0,07 V/m). For such symptoms as sleep problems, depressions, cerebral symptoms, joint problems, infections, skin problems, cardiovascular problems as well as disorders of the visual and auditory systems and the gastrointestinal tract, a significant dose-response relationship was observed in relation to objectively determined exposure levels. The impact of microwave radiation on the human nervous system serves as an explanation.
Carried out without outside funds, the study presented here provides a protocol concept that allows physicians and municipalities to cooperate and assess the potential human health impact of cell phone base stations located within residential areas.

Keywords: symptoms, cell phone radiation, wireless technologies, dose-response relationship

Participating offices: Dr. Brömel/Pozder, Schulstraße 4, 95197 Schauenstein; Dr. Jahn, Brunnenstraße 1, 95152 Selbitz; Dr. Müller, Wildenberg 22, 95152 Selbitz.

Deutsche Zusammenfassung

In der bayerischen Stadt Selbitz wurden im Januar 2009 zuerst durch die Gemeinde im Rahmen einer Gesundheitsbefragung relevante Daten von 251 Einwohnern erfasst und anschließend daran nach Belastungsstärken durch Mobilfunkwellen ausgewertet.
Die Belastungswerte wurden in einem zweiten Schritt an hand von Wohnort und vorliegenden Messdaten der örtlichen Mobilfunkstrahlung zur Stratifizierung der Teilnehmer in Belastungsgruppen verwendet.
Die mittlere Strahlenbelastung der höchstbelasteten Gruppen in Selbitz (1,2 V/m) lag deutlich höher als die untersuchte Studienpopulation der QUEBEB-

Studie (1) des Deutschen Mobilfunkforschungsprogramms (Mittelwert DMF O,07V *Im).* Fürdie Beschwerden Schlafstörung, Depressionen, cerebrale Symptome, Gelenkbeschwerden, Infekte, Hautveränderungen, Herz-Kreislauf Störungen sowie Störungen des optischen und akustischen Sensoriums und des Magen-Darm-Traktes besteht eine signifikante dosiswirkungsabhängige Korrelation zu objektiv bestimmten Expositionslagen, die mit dem Einfluss von Mikrowellen auf das Nervensystem des Menschen erklärt wird.
Die vorliegende fremdmittelfrei erstellte Arbeit gibt einen Konzeptentwurf vor, mit dem Ärzte und Gemeindeverwaltungen gemeinsam den gesundheitlich relevanten Einfluss von innerörtlichen Mobilfunksendern abschätzen können.

Introduction

Over the last decades wireless technologies have gained in importance. As a result, however, TV and radio stations are no longer the broadcasting sources that cause the highest exposure levels in residential areas; now it is cell phone base stations. Since 2003 the German Commission on Radiological Protection (SSK) has explicitly pointed out that there is a lack of knowledge about the consequences of these technologies on human health (2).

In Upper Franconian Selbitz, the municipality collaborated with local medical offices[1] whereby two separate data sets—a general health survey and available RF measurements—were used to correlate gathered symptom scores with independently available RF emission measurements of relevant cell phone radiation.

Materials and Methods

Selbitz in Upper Franconia is located in the northeast of Bavaria, Germany, having a total population of 4,644 (2,171 male and 2,473 female) on 31 December 2008 (3).
Cell phone coverage is available across the entire municipality. In the center, cell phone transmitters of two service providers are located in the street *Feldstraße 28* and the installation of a third telecommunication service provider is located in the street *Burgstraße 26a* (4).

Fig. 1:
Cell Phone Transmitters on Top of the Multistory Building at Feldstraße 28, Selbitz, Upper Franconia

As part of a survey in 2009, Selbitz municipality sent standardized health questionnaires by mail to 1,080 persons within the municipality and surrounding areas. The participants were aware that they could receive a questionnaire when they lived within a 400-m radius of the cell phone base station at *Feldstraße 28* or also outside of this radius. There were no personal interviews. A total of 88 sets of information on health symptoms were gathered, using a quantitative scale of zero to five. The symptom groups based on clinical entities were summarized as clusters for the assessment (Table 1).

	Symptom Group	Symptom Number
1	Sleep disorders	1-5
2	Symptoms of depression	6,7,18-23
3	Headaches	8
4	Cerebral affections	8-12
5	Concentration difficulties	24-29
6	Joint problems	30-34
7	Toothaches	35
8	Infections	36-41
9	Skin problems	42-47
10	Dizziness	55
11	Cardiovascular problems	48-52
12	Auditory system, Disturbance of equilibrium	56-61
13	Visual problems	62-67
14	Nosebleed	68
15	Hormonal imbalances	70-74
16	Weight gain	75
17	Weight loss	76
18	Gastrointestinal problems	77-81
19	Bedwetting	85

Table 1: Summary of Symptom Groups Based on Clinical Entities

The cover letter of the invitation to participate stated that participant confidentiality is ensured. The questionnaires could be returned or sent back to Selbitz municipality or the local doctor's offices. After the questionnaires were returned, the personal information form was separately filed from the symptom information form at the doctor's office of Dr. Eger, Naila. The anonymously coded symptom information forms were then passed on for data entry to the administrative staff of Selbitz municipality. The staff of the IT department entered the anonymized data into an Excel table for analysis.
On the personal information form, the existence of a DECT phone in the residence was indicated by a simple checkmark, which was also entered into the data pool.

All participants who returned their questionnaires were classified into groups based on their residential address. The circles drawn in Figure 2 show distances of 100 m, 200 m, 300 m, or 400 m from the two cell transmitters installed on the building of *Feldstraße 28*, identifying the groups 1 to 4. One control group (group 5), which can be classified as low-emission, includes participants outside the 400-m radius directly in Selbitz and also from surrounding areas that are further away from the municipality.

According to the elevation map, the landscape around the transmitter is level toward the west and east, gently rises toward the north, and declines with 7° to 9° toward the south.
The cell phone facilities of the service providers are located at a height of 19.20 m, 20.20 m, and 23.50 m above ground with the actual transmitters at 19.35 m and 22.70 m. The down tilt of the transmitters is given with 8°. The frequency ranges used are at about 940 MHz and 1850 MHz (5).

Under these conditions, the area where the main beam touches the ground is located almost 200 m away from the transmitters. Within the 200-m radius additional side lobes are to be expected.

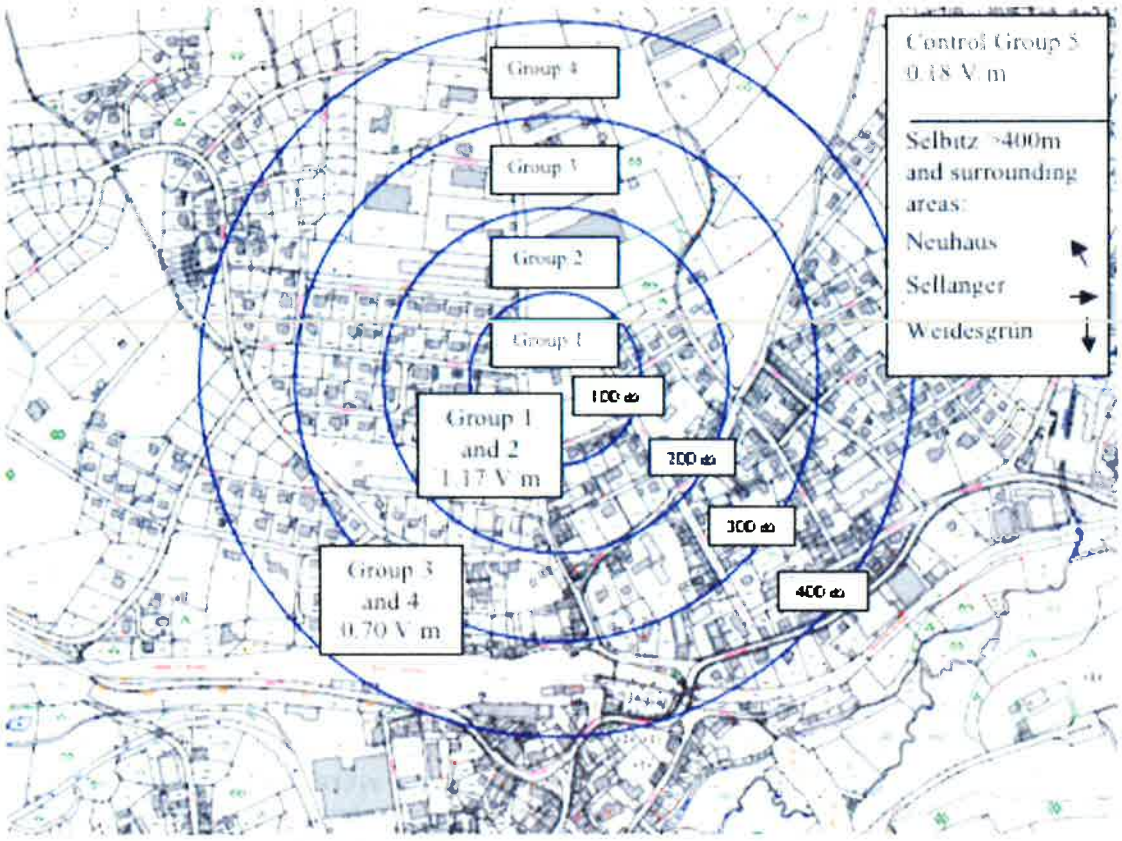


Fig. 2: The map from the land title office shows in the center of the concentric circles the cell transmitters at Feldstraße 28 in Selbitz. (Source: 5, With kind permission of Selbitz municipality)

Testing Situation and Measurement Results

Based on the testing report by the accredited company ECL, mean exposure values of the cell phone radiation could be assigned to the individual exposure groups (6). For the groups 1 and 2 the mean value is 1.17 V/m, for the groups 3 and 4 0.7 V/m.
The testing results for the area outside the 400-m radius were on average at 0.18 V/m and serve as a reference value. Weidesgrün area showed the lowest measurements with 0.01 V/m.

The analysis is performed by using a two-tailed t-test of two unrelated samples for a total of 19 symptom scores of the individual groups 1 through 5 to test the null hypothesis that the symptom scores of the compared groups are evenly distributed and thus independent of the radiation effect (7).

The comparison of the health-relevant data was carried out based on two concepts:

A) Comparison of the participant groups 1 to 4 within the 400-m radius of the transmitter location to the control group outside the 400-m radius in Selbitz/surrounding areas.
B) Comparison of the participant groups within the 400-m radius of the transmitter location, comparing the highest-exposure groups 1 and 2 to the groups 3 and 4 further away.

Results

A total of 255 persons above the age of 18 participated in the survey; 4 questionnaires could not be evaluated. This corresponds with a response rate of 23% from 1,090 questionnaires sent out. In total, the groups 1 to 4 close to the transmitter had a response rate of 22% and the control group's rate was 27%, thus displaying no significant difference in the response rate (Table 2).

For all participants the gender ratio of 43% male and 57% female applies, which roughly corresponds with the ratio of the statistically registered inhabitants of Selbitz with 47% male and 53% female (Table 3).

For groups 1 through 4, the control group 5, and persons in Selbitz from the age of 18, the average age is 54.5, 52.0, and 53.5 years.
The age distribution in 5-year increments corresponds with the total population in Selbitz (Table 3, Figure 3a-e). The survey participants, thereby, represent an age-representative sample of the total population of all inhabitants of Selbitz from age 18.

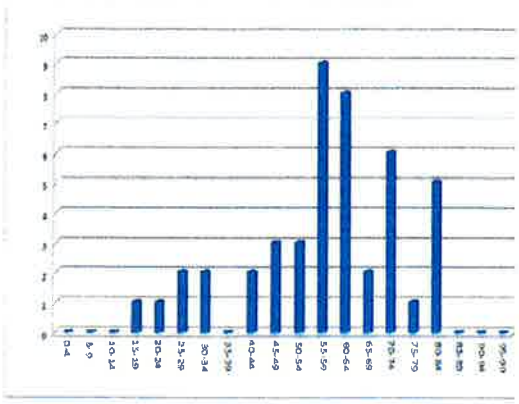
Within the 400-m radius around the transmitter, a higher symptom rate could be documented for 14 out of 19 symptom groups in the highest exposure groups 1 and 2 close to the transmitter compared to groups 3 and 4 further away from the transmitter (Table 4). The difference is statistically significant.

	Mailouts	Responses Number/(Percent)	Nonresponses Number/(Percent)	Comparison of Responses/Nonresponses incl. Control Group 5 (chi-square test)
Groups				
1	125	45 (36.0%)	80 (64.0%)	n.s.**
2	144	37 (25.7%)	107 (74.3%)	n.s.
3	281	60 (21.4%)	221 (78.6%)	n.s.
4	273	38 (14.0%)	235 (86.0%9	$p < 0.01$ (chi^2)
Control Group 5	254	71 (28.0%)	183 (72.0%)	
Sum	1077*	251	826	

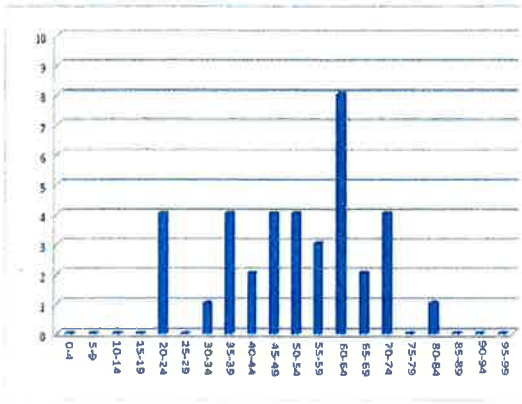
Table 2: Distribution of Questionnaires in Groups 1 to 4 and Control Group 5 according to Responses and Nonresponses.
With the exception of the low response rate in group 4, the differences between the responders/nonresponders of the individual groups and the control group 5 are not statistically significant.
*Three persons of the 1,080 surveys sent out could not be assigned.
** n.s. = not significant

	Number	Gender Male/Female (in %)	Age in 5-year Increments** Mean/Median	Distance from Transmitter at Feldstraße	Mean Exposure Levels of Cell Phone Radiation in V/m
Groups					
1	45	47/53	57.5/57	0-100 m	1.17 V/m
2	37	41/59	52.0/52	100-200 m	
3	60	40/60	55.0/57	200-300 m	0.70 V/m
4	38	42/57	53.5/52	300-400 m	
5	71	44/56	52.0/52	> 400 m	0.18 V/m
Selbitz*	4644	47/53	53.5/52		

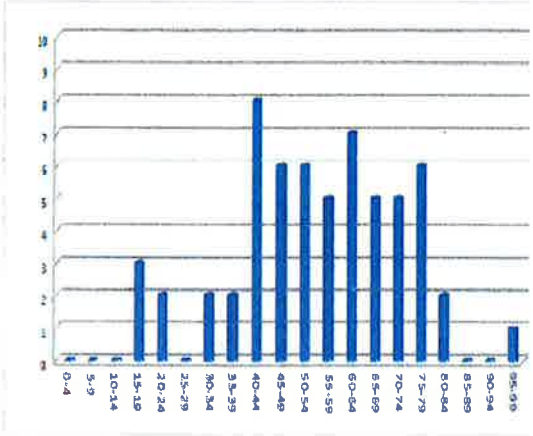
Table 3: Overview of Investigated Groups Based on Gender, Age, Residential Location, and Exposure Level. Groups 1-4 with a total of 180 participants are located within the 400-m radius of the transmitter. The 71 participants of control group 5 are further away than 400 m. Both the gender distribution as well as the comparison of age groups does not statistically differ from the total population of Selbitz.
* For the comparison of the mean age only persons above the age of 18 were chosen from the Selbitz population. Total population of Selbitz: 4,644; Inhabitants above age 18: 3,890.
** Age values are given within 5-year groups.



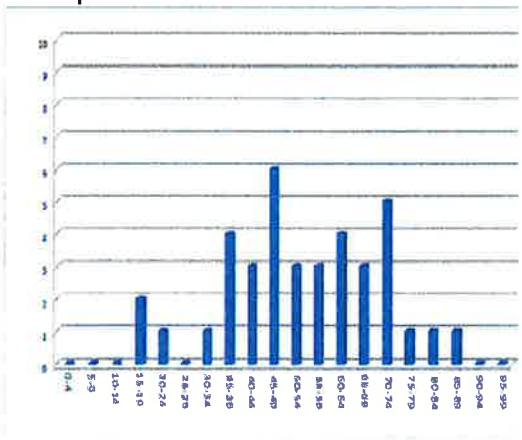
Group 1



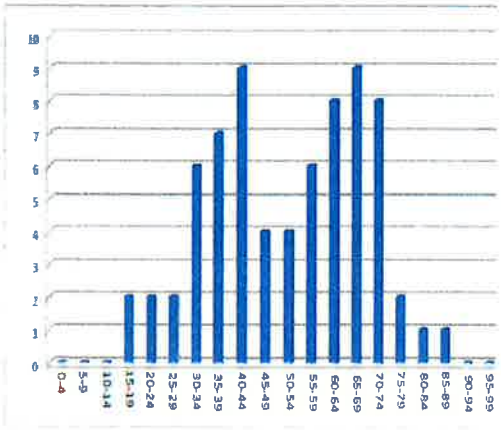
Group 2



Group 3



Group 4



Control Group 5

Fig. 3a-e: Age Distribution in Groups 1-4 and Control Group 5 in 5-year Increments

	A Comparison of Groups 1 to 4 (0-400 m/n=180) to control group 5 (> 400 m/n=71)	B Comparison of Groups 1 and 2 (0-200m/n=82) to groups 3 and 4 (200-400 m/n=98)
Symptoms	**Significance level p (t-test)**	**Significance level p (t-test)**
1 Sleep problems	0.001	0.001
2 Symptoms of depression	0.001	0.001
3 Headaches	n.s.	0.001
4 Cerebral affections	0.001	0.001
5 Concentration difficulties	n.s.	0.001
6 Joint problems	0.01	0.001
7 Toothaches	n.s.	n.s.
8 Infections	0.01	0.001
9 Skin problems	0.001	0.001
10 Dizziness	n.s.	0.01
11 Cardiovascular problems	0.001	0.001
12 Auditory system Disturbance of equilibrium	0.01	0.001
13 Visual problems	0.01	0.001
14 Nosebleed	n.s.	0.01
15 Hormonal imbalances	0.05	n.s.
16 Weight gain	n.s.	n.s.
17 Weight loss	n.s.	n.s.
18 Gastrointestinal problems	0.01	0.001
19 Bedwetting	n.s.	n.s. = not significant

Table 4: Specific Symptoms of Study Participants in Relation to Distance from Emission Source

A) Comparison of participant groups 1 to 4 around the transmitter to control group outside 400-m radius in Selbitz/surrounding areas

B) Comparison of participant groups within 400-m radius of transmitter. Groups 1 and 2 with the highest exposure are compared to groups 3 and 4 with a lower exposure level further away from the transmitter. Exposure levels for groups 1 and 2 were 1.17 V/m, for groups 3 and 4 0.7 V/m, and for control group 5 0.18 V/m.

In comparison to the control group, significant ($p < 0.01$, t-test) differences were found for the following symptom groups in the four exposure groups 1 to 4 located close to the transmitter: sleep problems, symptoms of depression, cerebral symptoms, joint problems, infections, skin problems,

cardiovascular problems, disorders of the visual and auditory system as well as hormone system and also gastrointestinal problems. The control symptoms "toothaches" and "bedwetting" were not significant (Table 4).
An overview of the documented mean values for all 19 symptoms or symptom scores is shown in Figure 4. The highest mean values are found mostly in the two highest exposure groups 1 and 2.

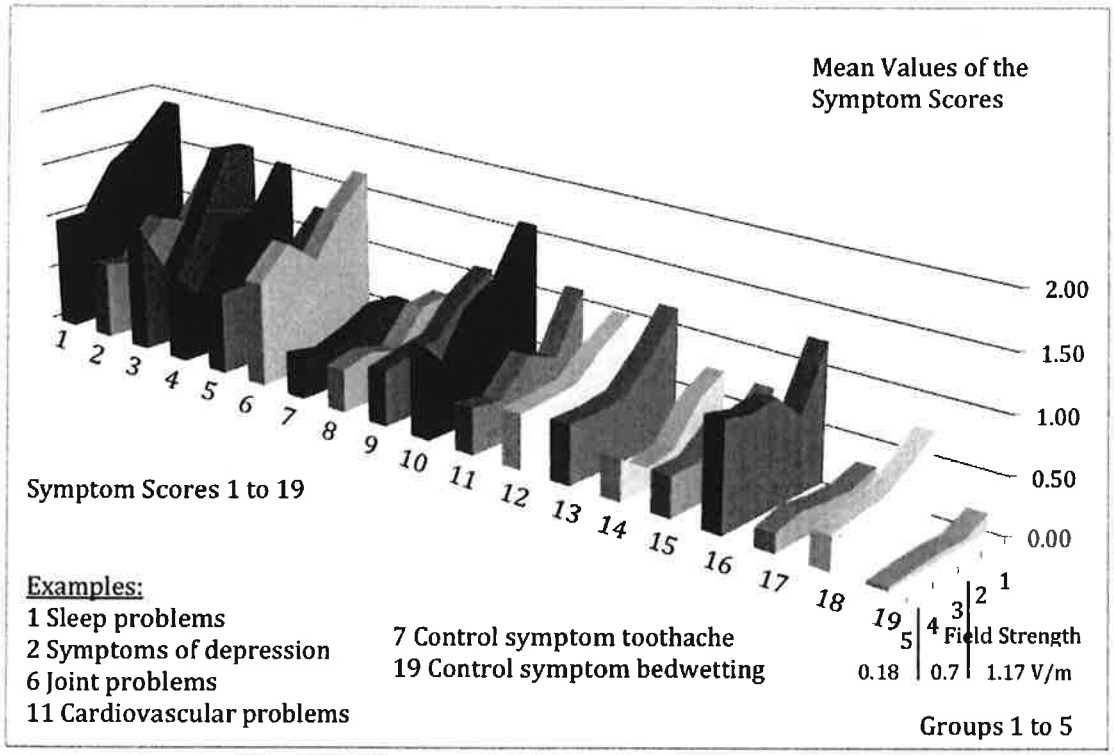


Fig. 4: Comparison of Specific Symptoms to Field Strengths
The spatial representation shows the 19 symptom scores on the y-axis where the mean value of each symptom score is plotted quantitatively. On the z-axis the exposure groups 1 to 5 are shown.

In Figure 5 and 8, the symptom scores for sleep problems, symptoms of depression, joint problems and cardiovascular problems are shown with their mean values and 95% confidence intervals. In a highly visual way, the significant relationships from Table 4 become obvious here.

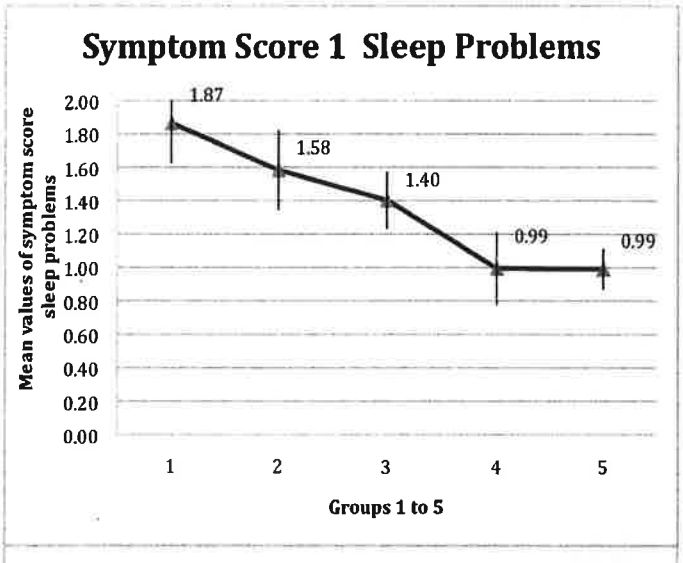


Fig. 5:
Control Symptom Score 1 for Sleep Problems for Groups 1-4 and Control Group 5
On the y-axis the mean values of the symptom scores are shown; the vertical bars at the result points represent the 95% confidence intervals.

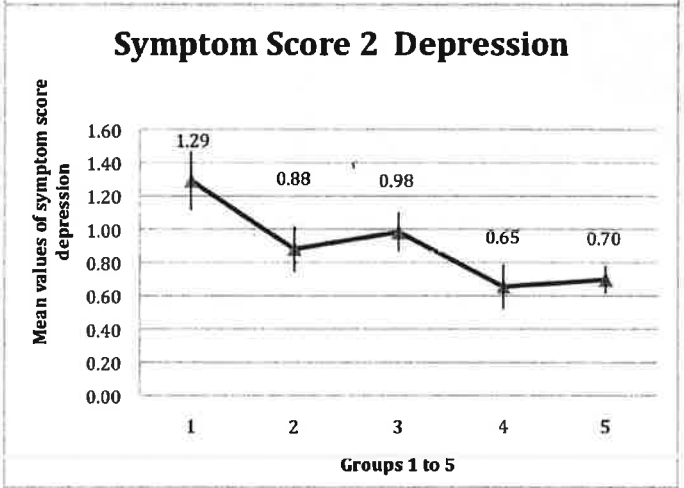


Fig. 6:
Control Symptom Score 2 for Symptoms of Depression for Groups 1-4 and Control Group 5
On the y-axis the mean values of the symptom scores are shown; the vertical bars at the result points represent the 95% confidence intervals.

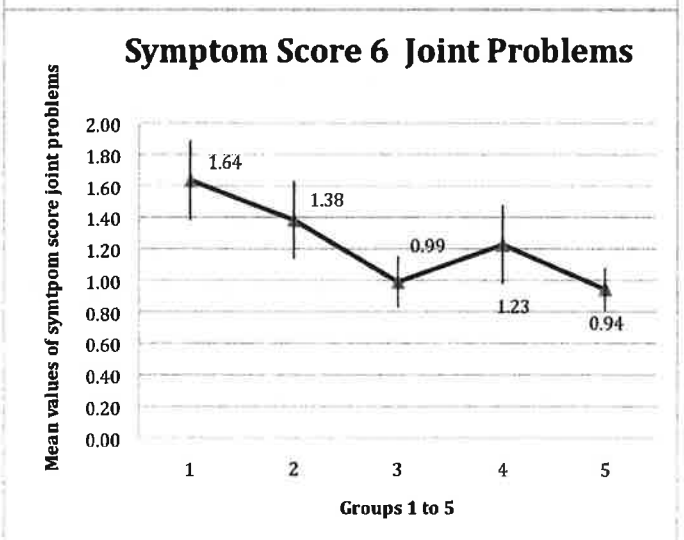


Fig. 7:
Control Symptom Score 6 for Joint Problems for Groups 1-4 and Control Group 5
On the y-axis the mean values of the symptom scores are shown; the vertical bars at the result points represent the 95% confidence intervals.

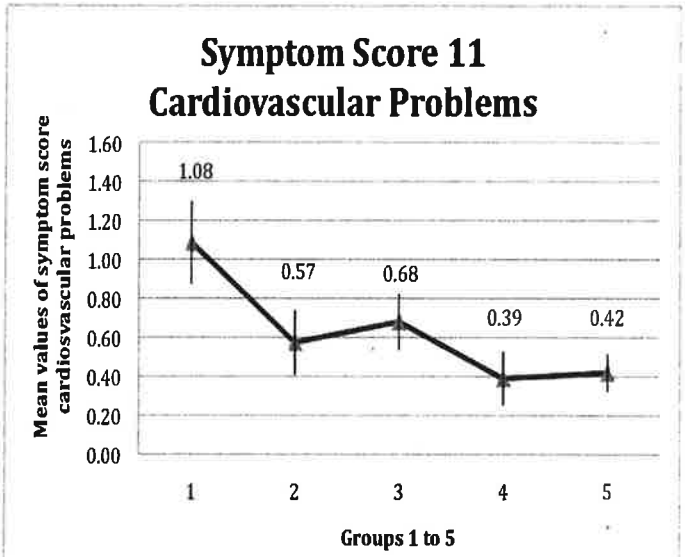


Fig. 8:
Control Symptom Score 11 for Cardiovascular Problems for Groups 1-4 and Control Group 5
On the y-axis the mean values of the symptom scores are shown; the vertical bars at the result points represent the 95% confidence intervals.

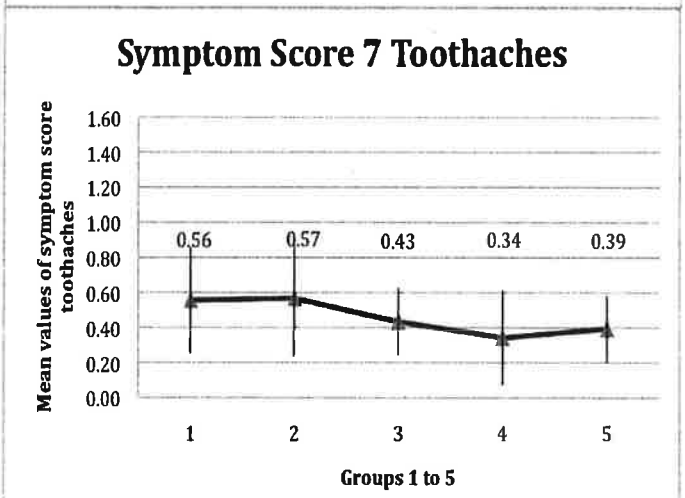


Fig. 9:
Control Symptom Score 7 for Toothaches for Groups 1-4 and Control Group 5
On the y-axis the mean values of the symptom scores are shown; the vertical bars at the result points represent the 95% confidence intervals.

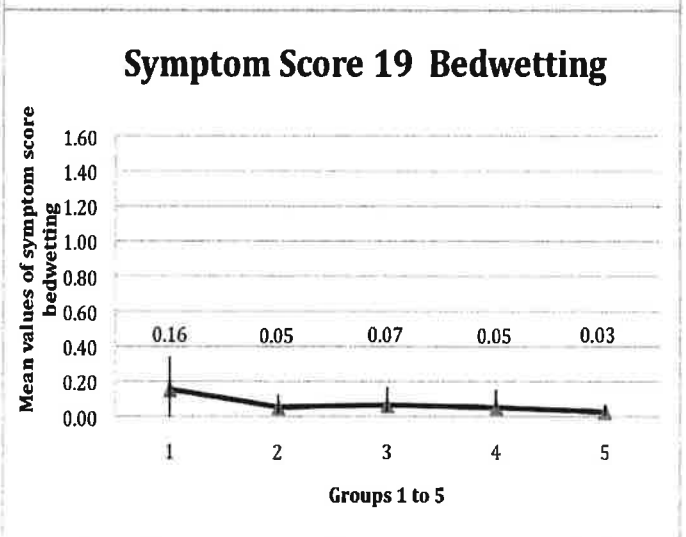


Fig. 10:
Control Symptom Score 19 for Bedwetting for Groups 1-4 and Control Group 5
On the y-axis the mean values of the symptom scores are shown; the vertical bars at the result points represent the 95% confidence intervals.

The symptoms "toothaches" and "bedwetting" served as controls in order to validate with these radiation-independent symptoms the plausibility of the participants' responses. There were no significant differences found for groups 1 and 2 in comparison to groups 3 and 4 or to control group 5, respectively (Table 4).

In a second step, we investigated if, within the 400-m radius, documented symptom scores are related to the distance or measured exposure level.

In Figure 11 the mean values are shown, comparing group 1 and 2 (upper black line) to group 3 and 4 (lower gray line).

Except for the symptoms toothache, hormone imbalance, weight gain, weight loss, and bedwetting, significant differences were found ($p < 0.01$; t-test).

Among the study participants a significant dose-response relationship was found between the theoretically calculated or measured exposure level and the symptom score levels.

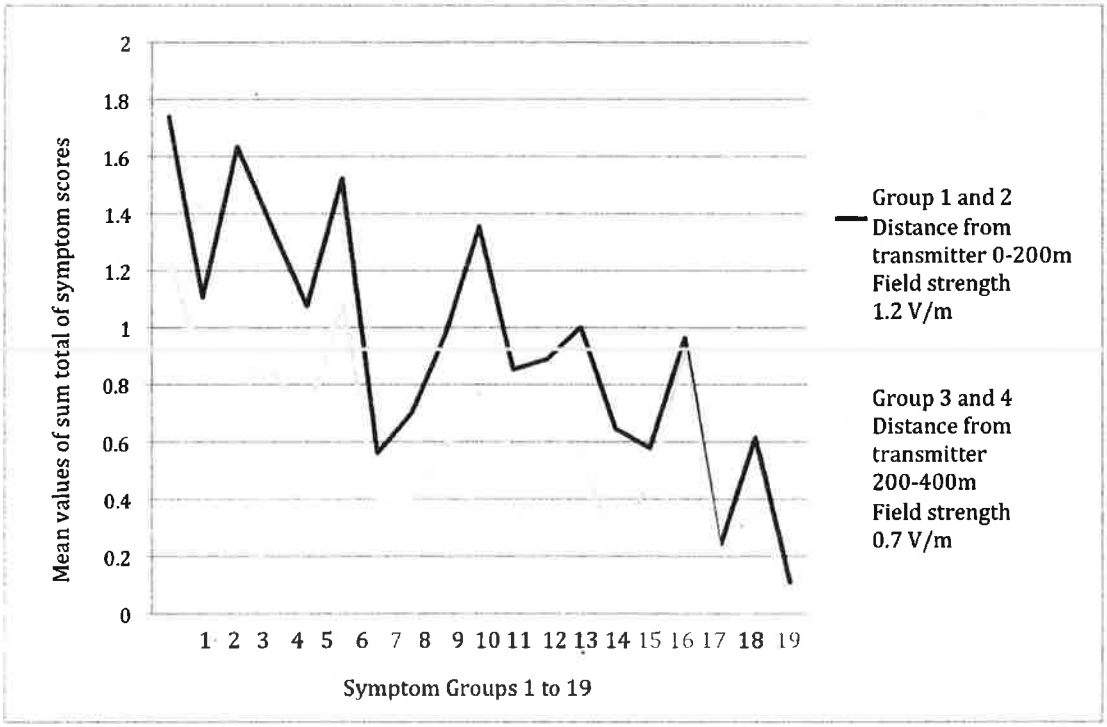


Fig. 11: Comparison of Groups 1 and 2 near the Transmitter to Groups 3 and 4 further away within the 400-m Radius
The numbers a shade lighter represent the nonsignificant symptom groups.

Data Gathering of DECT Phone Use

In the personal information form, participants could checkmark whether they have a DECT phone in their household. Out of 251 participants, 171 said they owned such a device and 80 said no. The average age of DECT phone users was with 50.5 years significantly lower than for those participants without a DECT phone (t-test, $p < 0.001$) so that no comparison group existed for individual relationships.

Discussion

The presented results show a significant relationship between mean exposure levels of the study participants and reported health symptoms.
For the highest exposure group, the mean microwave exposure is given with a field intensity of 1.2 V/m. An additional question concerning the use of DECT phones at home revealed an additional background exposure level in all participating households.
The graphs show clear trends for decreasing symptom scores in relation to decreasing mean exposure levels caused by cell phone transmitter emissions.

The comparison with the national and international research to classify these results provides additional arguments for nonrandom relationships.

Within the framework of the German Mobile Phone Programme (DMF), the QUEBEB study also investigated if health symptoms in the population could be associated with cell phone base stations and measured microwave radiation levels.
This study did not show any significant relationships because the highest measurement is given with 1 volt per meter, whereby 99% of the measurements are below 0.34 V/m. The mean exposure level was at 0.07 V/m with a 95% percentile at 0.17 V/m (1).

While less than 1% of the participants of the DMF study were exposed above 0.34 V/m, 82 out of the 251 study participants in Selbitz belonged to a high-exposure group above 0.7 V/m, that is, 32.7%.
High exposure groups as found in Selbitz did basically not occur in the samples of the German Mobile Phone Programme. To a certain degree, this has to do with the method of random sampling and leads to a systematic underestimation of the risk for population groups with higher exposures. Thus the finding of the QUEBEB study that found no correlation applies only to low-exposure groups and does in no way contradict the findings in Selbitz.

In Germany where complete cell phone coverage is provided, the Federal Office for Radiation Protection (BfS) has received highly important information about the health problems affecting residents living next to cell phone base stations. In a meeting on 2 August 2006 in Neuherberg, strongly worded official medical reports were quoted that document problem situations in particularly highly exposed households (17-19).

It has become known to industry that the health of their technicians is damaged (20,21).
There are already efforts under way to explore possibilities of how the electromagnetic pollution in wireless networks could be reduced. The reasoning for a patent filed in 2003 explicitly quotes evidence of damage in human DNA (22).

Since the 1960s long-term, nonthermal effects on the human central nervous system have been causally linked to microwaves, ultrashort waves, and shortwaves in several studies.

As part of a dissertation, Wenzel studied the health status of radio personnel in East German military forces (NVA) and summarized his results in a report that was confidential until 1989. In comparison to a nonexposed group, he observed an increase in headaches, sleep problems, general fatigue, eye pain, stabbing pain in the chest, declining mental power, irritability, dizziness, tendency to sweat, and visual problems. As a result of his findings, the inadequacy of the current exposure limits had already been pointed out in 1967 (9).

The review of occupational surveys in the Soviet Union between 1960 and 1996, which had been carried out by Prof. Hecht on behalf of the Federal Office for Telecommunications, revealed causal links for microwave radiation as a stressor of the central nervous system (26).

In 1960 Iranyi et al. from Hungary reported for the first time in the *Munich Medical Weekly Journal* about a substantially increasing number of health problems in radio personnel of "modern" radio stations that had been validated by measurements and confirmed by medical doctors, including headaches, dizziness, tiredness, sleep problems, tremors, and other symptoms. The symptoms occurred from field intensities above 3.8 V/m. There was no indication of simulated complaints. Because the symptoms occurred during their working hours and were associated with the number of years of employment, the authors concluded that there is a causal link between symptoms and exposure levels (10).

In 1962 Miro found increasing cases of pain, dizziness, nausea, personality changes, weight loss, fever attacks with chilling and sweating, and general fatigue in French radar personnel. The RF radiation exposure was at ca. 5 V/m (8).

In 1996 a study by the Swiss Federal Office of Energy around the shortwave transmitter at Schwarzenburg in Switzerland documented highly significant health problems in the civilian population regarding sleep problems, headaches, joint pain, fatigue, and other symptoms. In a blinded follow-up study, symptoms started to improve one day after the transmitter was turned off (11-13).

In 2002 Santini et al. had also demonstrated a clear dose-response relationship for the following symptoms in the vicinity of French cell phone base stations: sleep problems, tiredness, fatigue, irritability, depression, and other symptoms. As a conclusion, it was recommended back then to install this type of transmitter no closer to residences than 300 m (14).

Similar findings were revealed in the work by Navarro et al. with the follow-up measurements by Oberfeld (Government of Land Salzburg, Health Department), in which case the measured exposure levels were highly significantly correlated with major health problems. Three groups showed the following field intensity distribution: group 1 – 0.02-0.04 V/m, group 2 – 0.05-0.22 V/m, and group 3 – 0.25-1.29 V/m (15).

In 2007 the paper by Abdel-Rassoul et al. showed significant problems of the central nervous system (headaches, memory problems, dizziness, tremors, symptoms of depression, sleep problems) in an exposed population compared to the control group. The measured field intensity of the group classified as exposed was 3 V/m (16).

The survey presented here included specific control questions to verify the credibility of the participants' responses. From the number of described symptoms, for example, it was possible to see that the questionnaires had not been filled out randomly. Thus the control question for "toothaches," a disease mainly caused by caries, showed no difference between the exposed and unexposed groups.
As was to be expected, the control symptom "bedwetting" occurred only in a very small percentage and also showed no difference between exposed and unexposed groups.

The relationship between the question "weight gain" and "weight loss" corresponded with the known clinical reality. The obesity prevalence (body mass index BMI > 30) in the population is on average at 20%, which corresponds with a value of 1 (20% of maximum value 5) in our symptom scores. Underweight is found only in ca. 1-6% of the German population, which is reflected in the low symptom score for weight loss at 0.2 in our study (28).
A trend toward voting behavior in terms of symptom aggravation could thus be ruled out.

The occurrence of the symptom groups sleep problems, depression, cerebral symptoms, infections, skin problems, cardiovascular problems, problems of the visual and auditory system as well as the gastrointestinal tract proved to be consistently and significantly higher in the exposed groups. As can be seen from the literature review, it has been known since the 1960s that RF electromagnetic fields and microwaves can trigger these symptoms (8-10).

Equally significant were differences for the scores of joint problems, which again replicated already published findings of the Schwarzenburg study, Switzerland (11-13).

The results presented here were statistically validated by the t-test (7). The often stereotypically quoted criticism of too small case numbers for a validation of an association was mathematically refuted by the application of this statistical test and its significant results.

Considerably more crucial is the limitation of the gathered data because of the noticeable self-selection of the participants compared to the total number of the survey sample, which is reflected in the low response rate to the questionnaires. However, neither the response rates of the entire 400-m radius around the transmitter nor the highest exposure area do significantly differ from the response rate of control area 5, which again suggests a homogenous response behavior and speaks against an overselection of allegedly sick persons (Table 2).

The approached participants, including persons from the 400-m radius around the cell phone transmitter at the *Feldstraße* as well as Selbitz residents from further away, did not know that they would be classified into groups based on their residential location and exposure level. Thus it was not possible for the participants to classify themselves into groups 1 to 5.
In follow-up studies one should try to increase the response rate by phone calls or personal interviews instead of relying on a single mailout as was done in this study.

In Selbitz municipality, there are proponents as well as critics of wireless technologies and also persons who are indifferent to it so that each group had the same opportunity to respond. The number of study participants who considered their health affected by cell phone radiation was 12% in Selbitz and, therefore, falls below the participation rate of 23%. This corresponds with a percentage of 9% as found in the DMF. Thus a selection bias was not detected.

The participating individual groups did not differ based on age or gender, respectively; the plausibility of the responses was validated within the study. It is therefore assumed that the documented results reflect the actual distribution of the health problems.
International definitions stipulate that adverse health effects caused by microwave radiation can only be regarded as verified if the explanation for a plausible effect mechanism is provided, studies are independently replicated several times, and no contradictions exist in other studies (23).

With the paper presented here, these conditions are met so that the ongoing demand for evidence has been met once again. When taking the low exposure levels into account, the negative results of the German Mobile Phone Programme are consistent.

Conclusions

Until 2009 the official protocol for the investigation of health problems in residents living next to transmitters amounted to nothing more than measuring exposure levels in affected households instead of on-site monitoring with transmitter shutdowns to investigate causal links.
From the compliance with the currently valid exposure limits, it was concluded without any further investigation—using the logic of reductionism—that below these exposure limits no health effects could occur because, first, the exposure limits have already been met and, second, no scientifically accepted studies are available. The latter statement is not up to the current state of science.

According to the *Federal Immission Control Act* (§ 22 BImSchG) as well as the German constitution (art. 2, para. 2 GG), during the operation of technical facilities health hazards to a third party must indisputably be ruled out.
With the *Federal Immission Control Ordinance* (26. BImSchV), the federal regulation maker establishes exposure limit regulations for electromagnetic fields whose specifications are required by acts and the constitution. But as the presented paper shows once more, a clearly increasing incidence of disease is already taking place far below legally binding exposure guideline limits.
Even if in legal terms, this is not yet proof for an individual-specific evidence of damage, the presented investigations make it clear that the conclusions drawn by the federal regulation maker from the results of the German Mobile Phone Programme, according to which no health risk is to be expected below the exposure limits of the 26. BImSchV, are scientifically and legally unjustifiable.

From a legal perspective, it should be noted here that the current exposure limit regulations basically do not provide sufficient protection against health risks. Insofar as official agencies still suggest that the exposure limits of the 26. BImSchV would be precautionary limits, these limits are now disproven—among others—through our investigation, as it showed a significantly increased health risk in the vicinity of cell phone base stations.

As has already been demanded by the European Parliament, current exposure guidelines need to be urgently reviewed. Because of the documented relationship between exposure and health symptoms, there is also an urgent need for further research to elucidate the detailed relationships of health symptoms.

It is a physician's responsibility—not bound by directives—to work towards the preservation of the natural basis of life regarding human health (24).
As representatives of public health agencies, state offices such as the Public Health Department, the State Office for the Environment, and the Bavarian Ministry of the Environment as well as higher-ranking government levels

such as the Federal Ministry of the Environment and the European Union are invited to specify the cause of this possible slow poisoning.

After shutting down the respective transmitters for half a year, a portion of the health symptoms reported by the study participants in Selbitz should become normalized. The significant clinical relevance of the observed results has been discussed.

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Note:
Upon request, the anonymized raw data can be provided by Selbitz municipality to scientific institutions.

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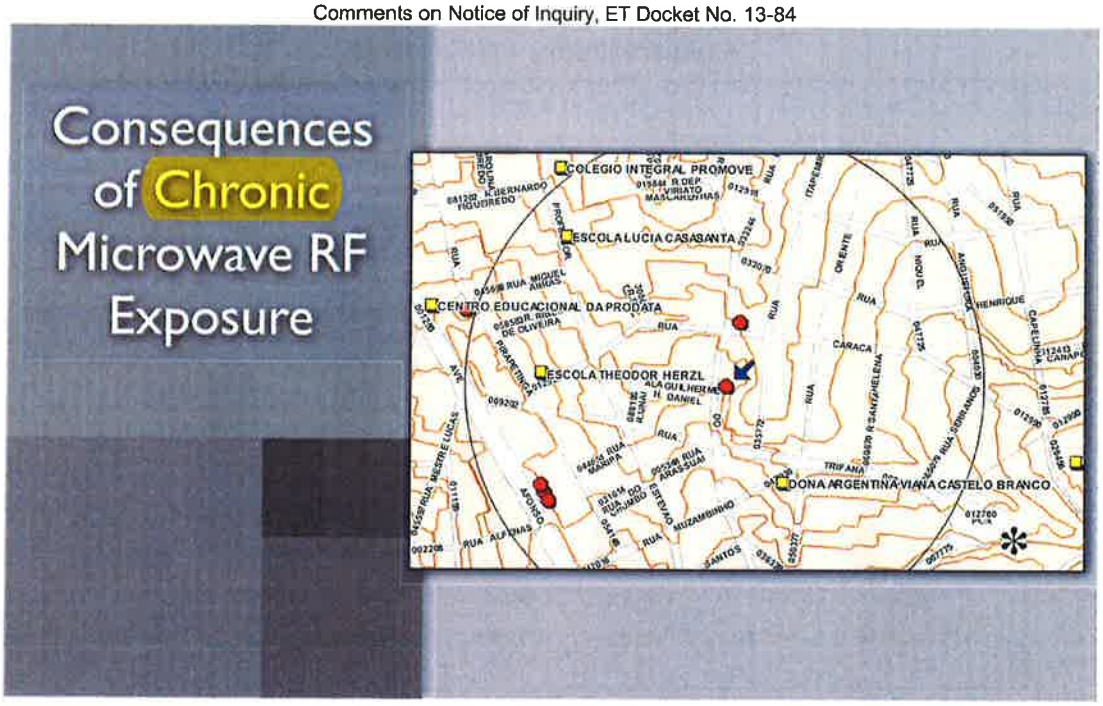

Fig. 2. Geographical location of BS Site BH 20 at 1373 Rua do Ouro Street, in the Serra neighborhood, Belo Horizonte municipality

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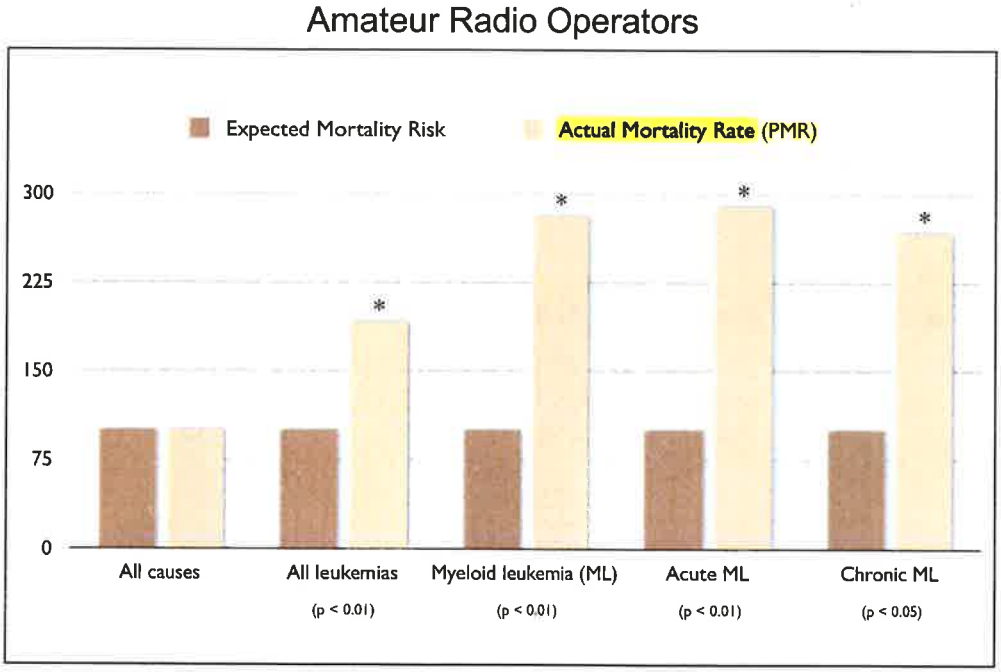

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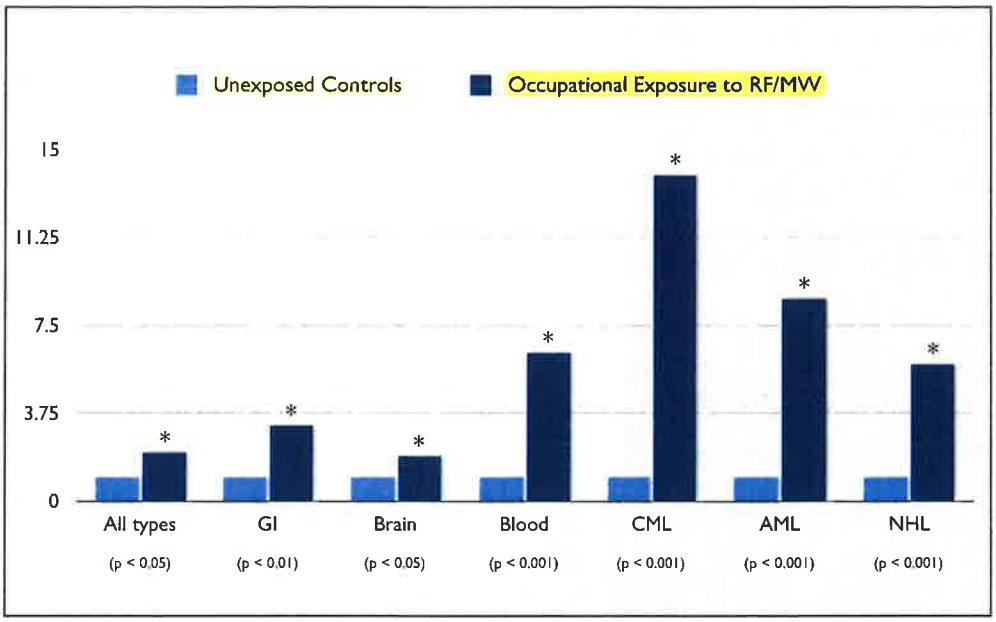
Polish Military (1971-1985)



Polish military personnel with occupational exposure to radio and microwave frequency radiation.

Odds ratio of cancer incidence (1971-1985)

CML = chronic myelocytic leukemia
AML = acute myeloblastic leukemia
NHL = non-Hodgkin lymphoma

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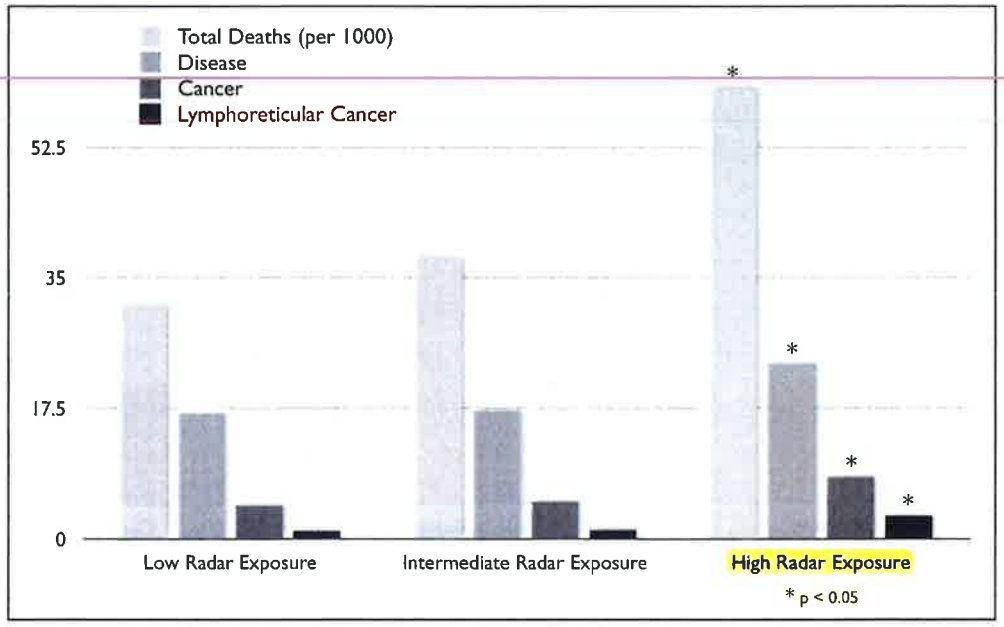
U.S. Navy Korean War Veterans (1950-1974)



Mortality in U.S. Navy Korean War Veterans (1950–1974) stratified by levels of occupational radar exposure.

Mortality 1950–1974. (Y axis = crude mortality per 1000) Stratified by level of radar exposure.

In the original paper, Robinette et al evaluated job exposure hazard levels of 6 categories of navy personnel and grouped them into two groups, low exposure and high exposure. The electronic technicians (ET) had a significantly lower hazard rating and lower levels of pathology than the other two job categories in the high risk group, so this classification diluted out the high exposure risk pool.

Dr. Cherry took Robinette et al's published data and divided the workers into three exposure levels. The above chart is the result of Dr. Cherry's analysis of the data set.

Robinette CD, Silverman C, Jablon S. Effects upon health of occupational exposure to microwave radiation (radar). *Am J Epidemiol* (1980); 112(1):39-53.

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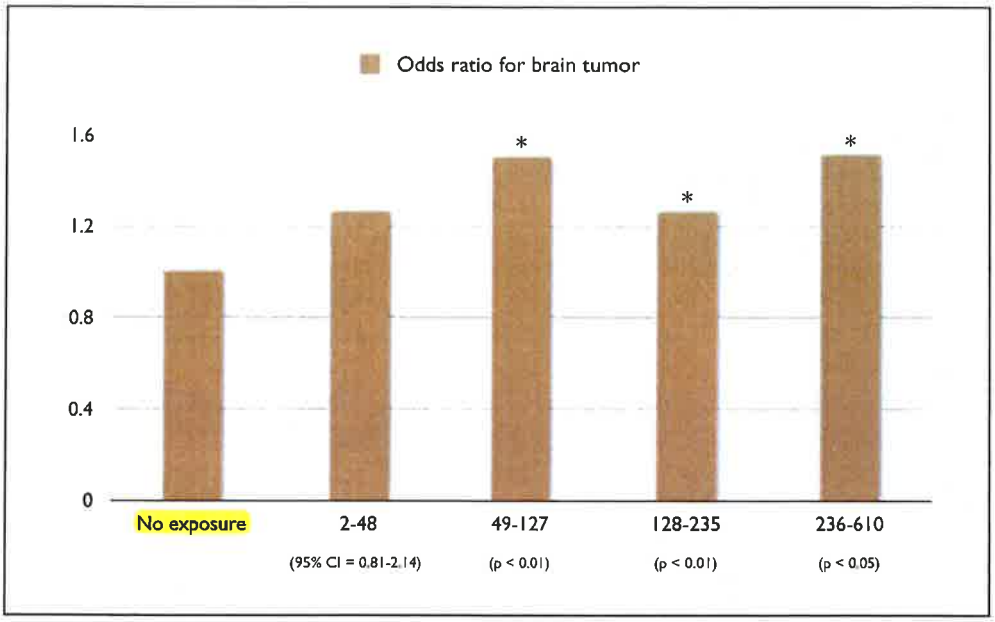
US Air Force (1970-1989)



US Air Force Workers with occupational exposure to microwave RF (1970–1989)

Y axis: Odds ratio for brain tumor

X axis: Exposure intensity score x months exposed)

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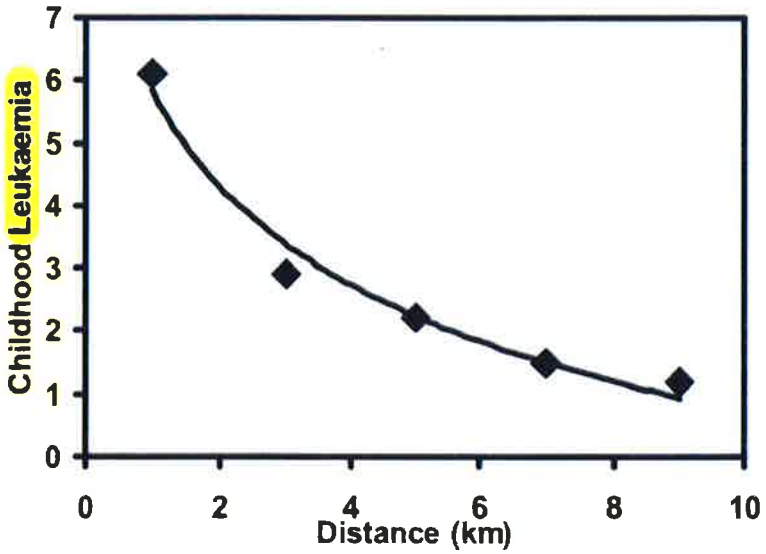
Vatican Radio Tower (1987-1999).



Cumulative childhood leukaemia near the Vatican Radio Transmitters in Rome, 1987–1999.

Multiple powerful transmitters on site.

10 km radius around towers contains a population of >49,650 (1990 census).

exponential fitted trend line, R2=0.9756, **p = 0.002**

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Netanya, Israel (1997-1998)

New cell phone tower set up in city of Netanya, Israel, in July, 1996.

1500 watt, 850 MHz.

Power density in the whole exposed area was **far below 0.53 µw/cm2.**

This is 1000 times less than the FCC Guidelines of 600 µW/cm² for 850 MHz exposure.

Comparison of cancer rates during the second year of exposure, in 677 long-term residents near the tower, compared to 1,222 matched controls living in another area of the city.

Wolf R, Wolf D. Increased Incidence of Cancer Near a Cell-Phone Transmitter Station. *International Journal of Cancer Prevention* (2004); 1(2):1-19.

Netanya, Israel - Relative Cancer Risk

Relative risk of cancer in residents near a new cell phone tower in Netanya, Israel, during the second year of exposure.

Overall risk of cancer in Area A was 4.15 times higher than in the town as a whole.

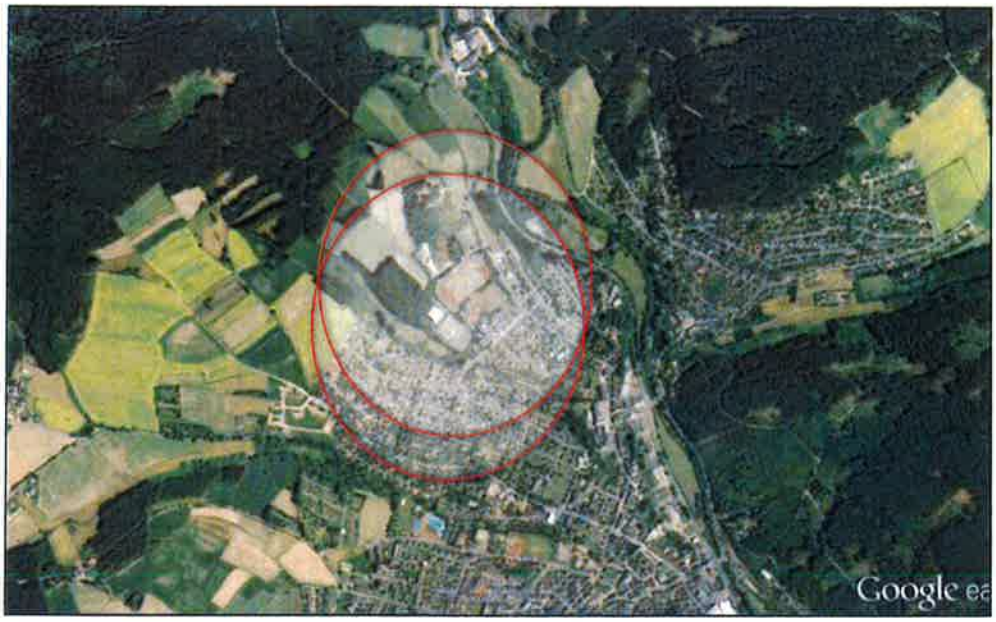
For men in area A, the cancer rate was 1.4 times higher.

For women in area A, the cancer rate was 10.5 times higher ($p < 0.0001$)

[the probability of this beeing a random finding is one hundredth of 1%

Wolf R, Wolf D. Increased Incidence of Cancer Near a Cell-Phone Transmitter Station. *International Journal of Cancer Prevention* (2004); 1(2):1-19.

Naila, Germany (1999-2004)



Town of ~ 1100 residents.

Cell tower installed in 1993.

Medical of 1000 residents reviewed for the years 1994–2004.

Comparison of cancer incidents in residents living within 400 meters of the cell phone tower, compared to residents living farther away, and compared to the death rates for the province as a whole.

Eger H, Hagen K, Lucas B, Vogel P, Voit H. The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer. *Umwelt-Medizin-Gesell-schaft* (2004); 17(4):1-7.

Cancer Incidence in Naila (1999-2004)

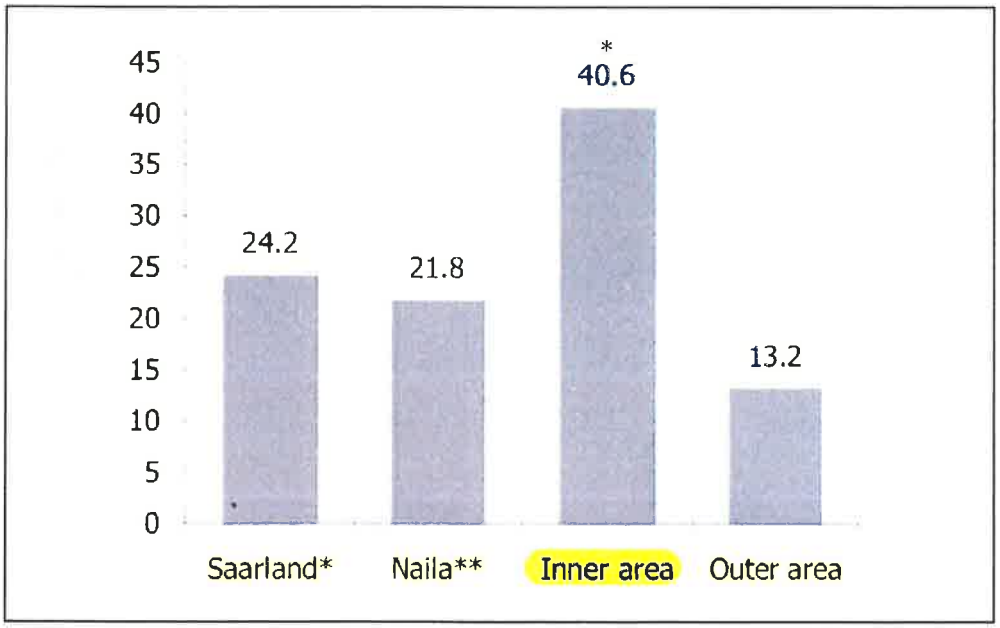


Fig. 3 : Number of new cancer cases 1999 to 2004, adjusted for age and gender, calculated for the 5,000 patient years

Y axis: Cancer incidence 1994 – 2004 (**new cases per 5000 patient years**).

* Saarland = predicted rate based on the cancer registry for the federal state of Saarland.

** Naila = incidence for the town as a whole.

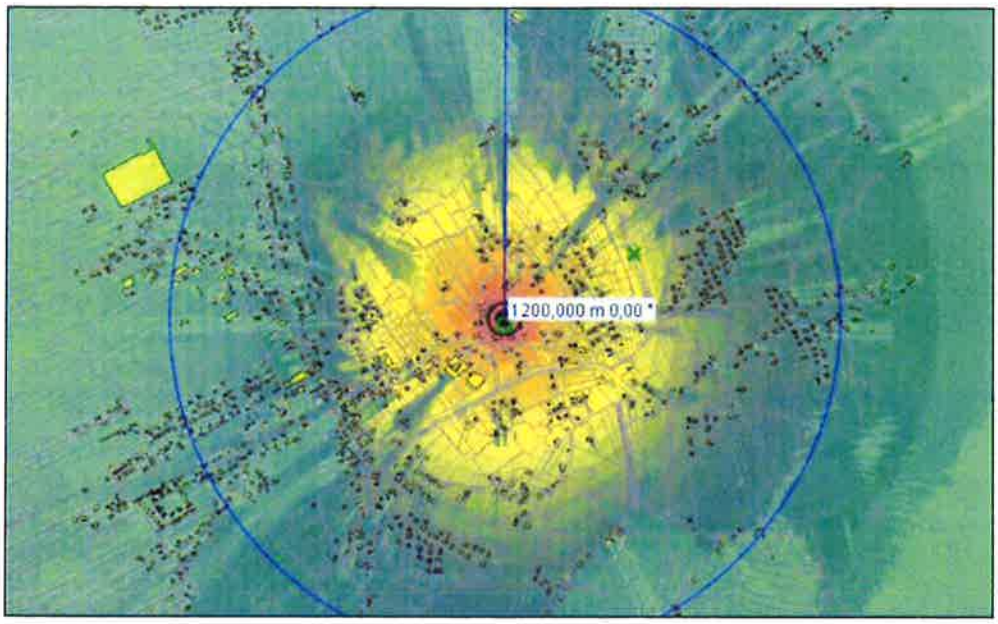
Inner area = residence within 400 meters of the tower.

Outer area = remainder of community.

In the inner area, the risk of cancer incidence was three times as high after five or more years of exposure.

In addition, the **patients that live within 400 metres tend to develop the cancers at a younger age.**

Hausmannstätten & Vasoldsberg, Austria (1984-1997)

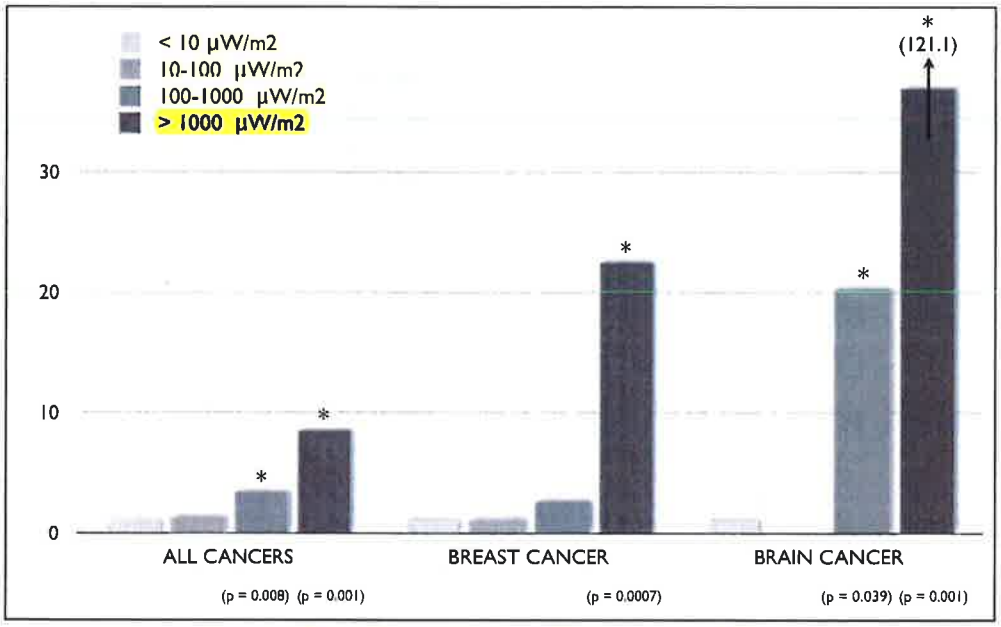


NMT 450 cell tower, operational from 1984–1997.

Case/control study of cancer patients living within 1200 meter radius of the tower.

Oberfeld G. Environmental Epidemiological Study of Cancer Incidence in the Municipalities of Hausmannstätten & Vasoldsberg (Austria). Provincial Government of Styria, Department 8B, Provincial Public Health Office, Graz, Austria (2008):1-10. *http://www.emf-health.com/PDFreports/Austrianstudy.pdf*

Hausmannstätten & Vasoldsberg, Austria (1984-1997)



Odds ratio of cancer incidence — stratified by exposure levels (exterior to dwelling) in $\mu W/m^2$.

Note: **FCC thermal safety guidelines ~ 6,000,000 $\mu W/m^2$)**

In the highest exposure category:

Breast cancer risk was 23 times higher,

Brain cancer risk was 121 times higher.

Oberfeld G. Environmental Epidemiological Study of Cancer Incidence in the Municipalities of Hausmannstätten & Vasoldsberg (Austria). Provincial Government of Styria, Department 8B, Provincial Public Health Office, Graz, Austria (2008):1-10. *http://www.emf-health.com/PDFreports/Austrianstudy.pdf*

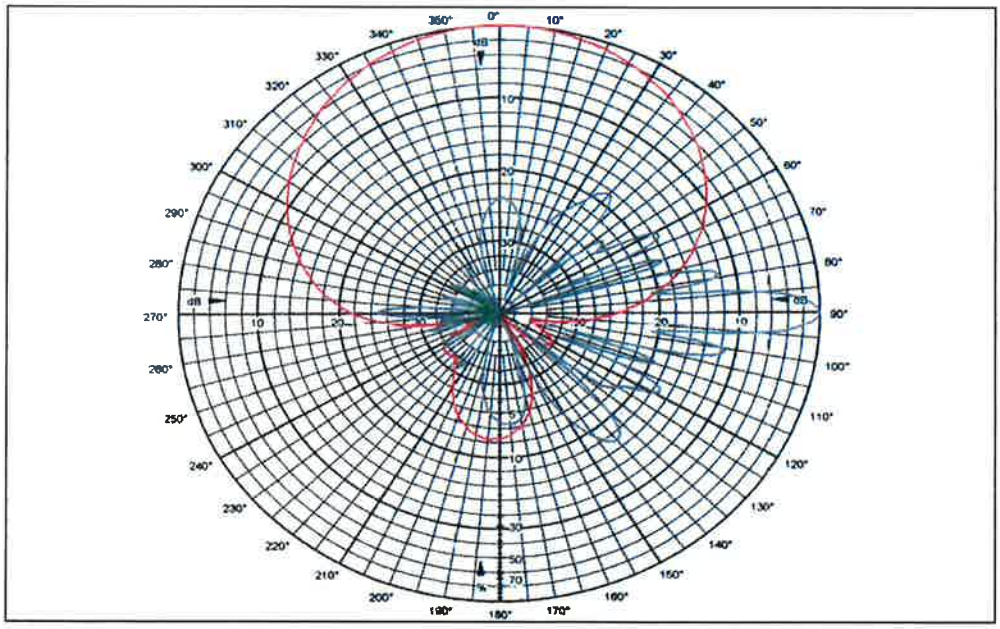
Belo Horizonte, Brazil (2011)

Belo Horizonte is the capital of Minas Gerais state in Brazil, population 2,258,096 in 2010.

Rated by the U.N. in 2007 as having the best quality of life in Latin America.

By 2006, 856 cell phone towers had been installed in the city.

Dode AC, Leao MM, Tejo Fde A et al. Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil. *Sci Total Environ* (2011); 409(19):3649-3665.



Environmental monitoring of RF power densities in the city was performed.

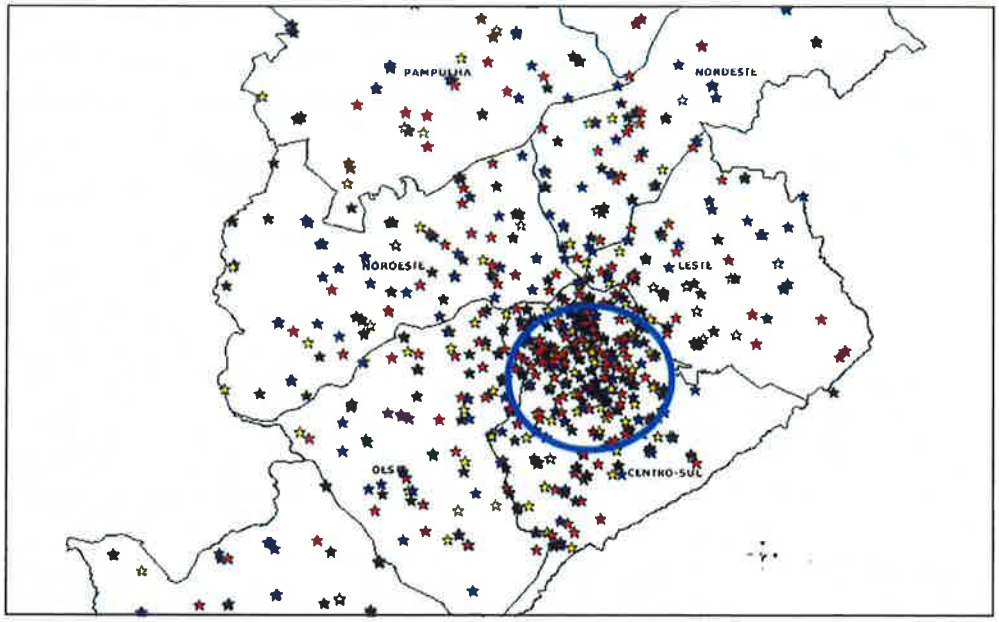
In 2003, the highest recorded power density in the city was 3.06 μW/cm2.

In 2008, the largest recorded power density was 40.78 μW/cm2, 13 times higher than in 2003.

40 μW/cm2 is 15 times less than the FCC Exposure Guidelines.

Fig. 3. Horizontal and vertical radiation patterns per sector of BS site BH 20

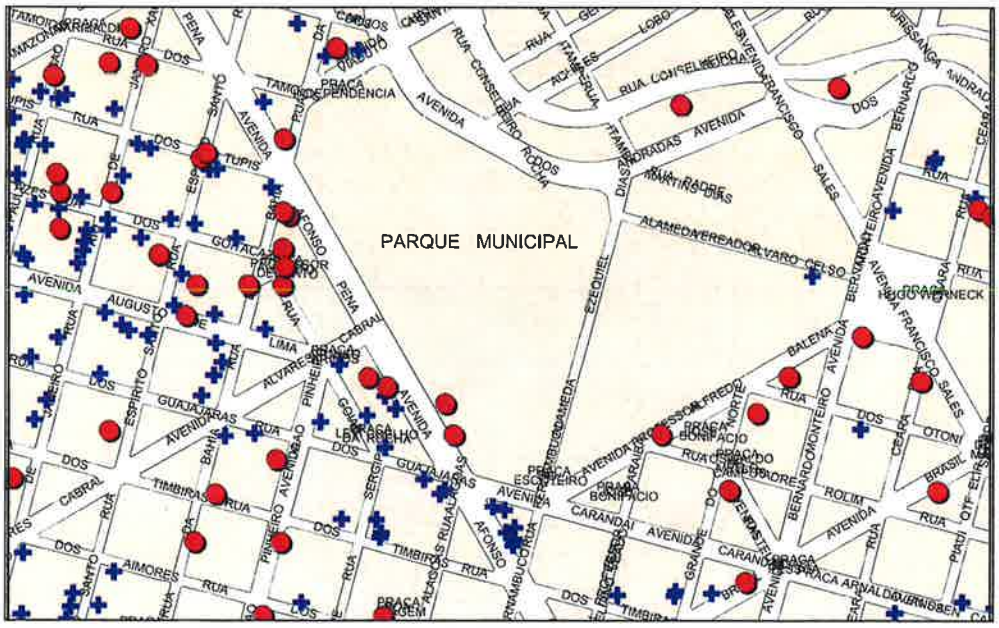
From: Dode AC, Leao MM, Tejo Fde A et al. Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil. *Sci Total Environ* (2011); 409(19):3649-3665.



The authors used the Telecommunications National Agency database to map the locations of the 856 cell phone towers that existed in the city as of December 2006.

Fig. 8. Installed BSs in the Belo Horizonte municipality until 2006. Total amount = 856.

Dode AC, Leao MM, Tejo Fde A et al. Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil. *Sci Total Environ* (2011); 409(19):3649-3665.



They then cross-referenced health department records of death by neoplasia
with census and demographic city population data
to **locate the residence** of all individuals who had died of cancer in the city between 1996 and 2006.

Fig. 10. Sample of geocoded deaths and BS locations in downtown Belo Horizonte City located in Central-Southern region.

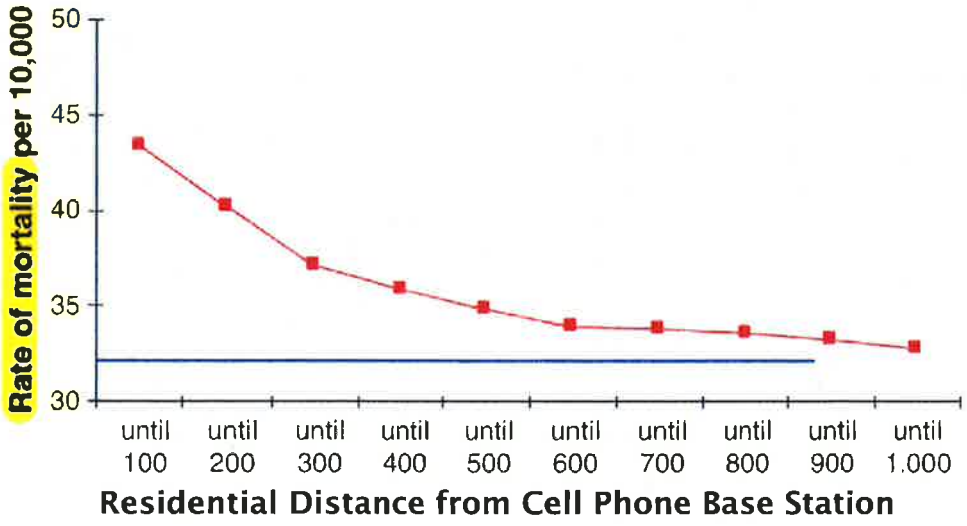
From: Dode AC, Leao MM, Tejo Fde A et al. Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil. *Sci Total Environ* (2011); 409(19):3649-3665.

Belo Horizonte, Brazil (2011)

This allowed them to calculate the distance between the deceased individuals' residences and the closest cell phone tower, in meters.

Dode AC, Leao MM, Tejo Fde A et al. Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil. *Sci Total Environ* (2011); 409(19):3649-3665.

Belo Horizonte, Brazil (2011)

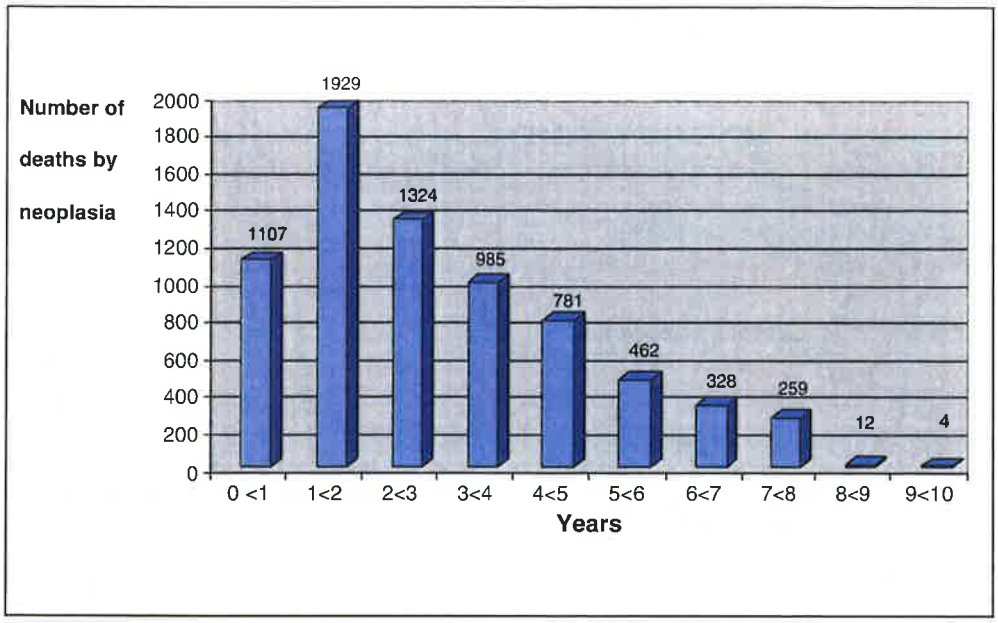


Analysis of this data showed that the cancer death rate was significantly elevated at proximities closer than 500 meters to cell phone towers.

Fig. 15. Rate of mortality by neoplasia, according to the distance from the BS in Belo Horizonte municipality, from 1996 to 2006, and the null hypothesis (blue line).

Dode AC, Leao MM, Tejo Fde A et al. Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil. *Sci Total Environ* (2011); 409(19):3649-3665.

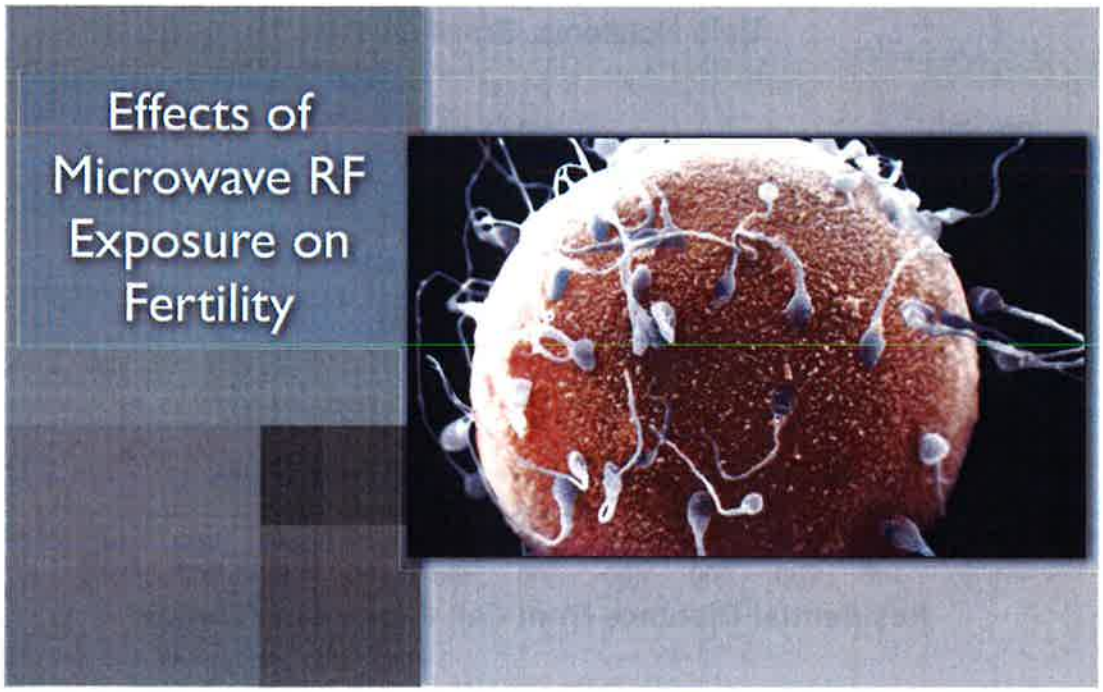
Belo Horizonte, Brazil (2011)



Death rates peaked during the second year of exposure.

Fig. 16. Distribution of the number of deaths by neoplasia versus duration of exposure since the date that the first antenna in each analyzed CT came into operation.

Dode AC, Leao MM, Tejo Fde A et al. Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil. *Sci Total Environ* (2011); 409(19):3649-3665.



Electromagnetic Fields

Original scientific publication

Significant Decrease of Clinical Symptoms after Mobile Phone Base Station Removal – An Intervention Study

Tetsuharu Shinjyo and Akemi Shinjyo

This research was undertaken to investigate the validity of concerns about whether chronic exposure to radiofrequency electromagnetic fields (RF-EMFs) emitted from mobile phone base station antennas could cause adverse health effects. The aim of this study was to identify possible adverse health effects among the residents of a condominium on which a mobile phone base station with sets of antennas operating at two different frequencies had been mounted. This research was conducted without outside funds in order to maintain neutrality and avoid pressures from external sources.

Methods: We investigated possible adverse effects on the health of condominium inhabitants who were exposed from 1998 to 2009 to the radiation from mobile phone base station antennas installed on top of their condominium. To accomplish this, in January and November 2009, 107 of 122 inhabitants were interviewed and underwent medical examinations. The first examination was carried out while the base station was in operation, the second examination three months after the base station antennas were removed once and for all. Based on the health examination results, the residents' health and its changes during the operation of the antennas and after their removal were compared.

Results: In several cases, significant effects on the inhabitants' health could be proven. The health of these inhabitants was shown to improve after the removal of the antennas, and the researchers could identify no other factors that could explain this health improvement. These examinations and interviews suggest that there are possible adverse health effects related to RF-EMF exposure among people living under mobile phone base stations.

Conclusions and recommendations: The results of these examinations and interviews indicate a connection between adverse health effects and electromagnetic radiation from mobile phone base stations. Further research and studies are recommended regarding the possible adverse health effects of RF-EMFs. These results lead us to question the construction of mobile phone base stations on top of buildings such as condominiums or houses.

Key words: mobile phone, base station, radiofrequency (RF), electromagnetic field (EMF), health problems, residents.

Signifikanter Rückgang klinischer Symptome nach Senderabbau – eine Interventionsstudie

Tetsuharu Shinjyo and Akemi Shinjyo

Hintergrund der vorliegenden Arbeit waren Befürchtungen, dass die chronische Exposition hochfrequenter elektromagnetischer Strahlung (HFS -EMF), die von den Sendeantennen von Mobilfunkbasisstationen ausgehen, negative Auswirkungen auf die Gesundheit haben könnte.

Ziel war es, die möglichen negativen Auswirkungen auf die Gesundheit der Bewohner einer Wohnanlage festzustellen, auf deren Dach zwei Mobilfunkbasisstationen montiert worden waren.
Aus Gründen der Neutralität und um äußeren Druck zu vermeiden, wurde diese Studie ohne Drittmittel durchgeführt.

Methode: Untersucht wurden mögliche negative Auswirkungen auf die Gesundheit der Bewohner einer Wohnanlage, die von 1998 bis 2009 der Strahlung zweier auf dem Dach befindlichen Mobilfunksendeantennen ausgesetzt waren. Dazu wurden 107 der 122 Bewohner im Januar und November 2009 befragt und ärztlich untersucht, wobei die erste Untersuchung während des Sendebetriebes und die zweite Untersuchung drei Monate nach dem endgültigen Abbau der Sendeantennen stattfand. Basierend auf den Ergebnissen der Gesundheitsuntersuchung wurden der Gesundheitszustand der Bewohner und dessen Änderungen während und nach dem Sendebetrieb verglichen.

Ergebnis: In mehreren Fällen konnten signifikante gesundheitliche Auswirkungen nachgewiesen werden. Der Gesundheitszustand dieser Bewohner besserte sich nach Senderabbau, wobei von den Untersuchern keine anderen Faktoren erkannt werden konnten, die diese Verbesserung hatte erklären können. Diese Untersuchungen mit Interviews legen den Schluss nahe, dass auf HFS- EMF zurückzuführende Auswirkungen auf die Gesundheit bei Menschen möglich sind, die unter Mobilfunkbasisstationen wohnen.

Schlussfolgerungen und Empfehlungen: Die Ergebnisse dieser Untersuchungen mit Interviews legen den Schluss nahe, dass es einen Zusammenhang gibt zwischen einer Verschlechterung des Gesundheitszustandes und Mobilfunkbasisstationen. Es wird empfohlen, weitere Forschungen und Studien bezüglich negativer Auswirkungen von HFS-EMF auf die Gesundheit durchzuführen. Diese Ergebnisse lassen uns die Installation von Mobilfunkbasisstationen auf Wohnhäusern in Frage stellen.

Schlüsselwörter: Mobilfunk, Basisstation, Hochfrequenzstrahlung (HFS), elektromagnetisches Feld (EMF), gesundheitliche Probleme, Bewohner, Anwohner.

Introduction

In 2011, the International Agency for Research on Cancer (IARC), a subsidiary body of the World Health Organization (WHO), officially declared radiofrequency electromagnetic fields (RF-EMFs) as possibly carcinogenic and a potential risk factor for gliomas and acoustic neuromas (IARC 2011). Moreover, it recommended taking precautionary measures to reduce exposure during mobile phone use, such as texting and the use of hands-free devices instead of holding the mobile phone next to the ear when talking.

However, the WHO has not issued any recommendation yet regarding adverse health effects of RF-EMFs emitted from mobile phone base stations. If there are health problems related to RF-EMF emitted from mobile phones, would the RF-EMFs from a mobile phone base station have the same effect? Mobile phone base stations constantly send signals to many mobile phones. Because of that, people living near base stations can be exposed to RF-EMFs 24 hours a day all the year (Khurana 2009). Today, there are a number of published studies concerning the impact of RF-EMFs emitted by base stations (Berg-Beckhoff et al. 2009, Blettner et al. 2009, Abdel-Rassoul 2007, Hutter et al. 2006, Eger et al. 2004, Wolf & Wolf 2004, Navarro et al. 2003, Santini et al. 2003). Some of these studies indicate possible health hazard to those living close to base stations (Berg-Beckhoff 2009, Blettner et al. 2009, Navarro et al. 2003, Santini et al. 2003). Some show a higher incidence of cancer (Eger et al. 2004, Wolf & Wolf 2004) or a higher cancer mortality (Dode et al. 2011). Hutter et al. (2006) reported that the stronger the RF-EMFs are, the higher the incidence of headaches and attention deficit disorders. Reduced cognition has also been documented (Abdel-Rassoul et al. 2007).

However, when studies like these are conducted on base stations, biases such as low frequency radiation (LF-EMF) and RF-EMF from the domestic living environment arise. Therefore, the more meticulous the research methodology is, the less significant the results indicated by the research. To get more precise results, it is necessary to eliminate biases as much as possible and to use double-blind procedures. However, conducting such research is difficult in reality.

The Situation in Japan

In Japan, there is presently little concern about the possibility of adverse health effects from mobile phones and mobile phone base stations. With the exception of a small number of cases, existing worries about mobile phones and mobile phone base stations have been ignored there (Sato et al. 2011). The reasons for this lack of attention are:

In Japan, the Ministry of Internal Affairs and Communications does not recognise any non-thermal effects from non-ionising radiation.

Furthermore, the possibility of adverse health effects is not accepted by that Ministry when power densities are below 1000 $\mu W/cm^2$ (1.8-5 GHz) (MIC 2011).
There are no official reports on the possible adverse health effects of RF-EMF emitted from mobile phone base stations in Japan. Risks and hazardous effects associated with these stations are not officially recognised in Japan. Reports about the risks of mobile phone base stations are seldom in the Japanese print and

broadcast media. A reason for this could be the mobile phone companies' media sponsorship.

Materials and Method

In 1998, a mobile phone base station was installed for the first time on the roof of the condominium in Naha City, Okinawa, Japan that is being investigated. Its antennas had an 800 MHz operational frequency [800 MHz code division multiple access (CDMA One)]. At the end of 2007, a further set of antennas with an operational frequency of 2 GHz (CDMA 2000) was installed. These were activated in March 2008. Figures 1A-D show the antenna installations on the condominium roof from different perspectives.

After the company owning the condominium withdrew its consent, the base station had to be removed. In June 2009, the 800 MHz installation was deactivated. It had been in operation for 11 years. The 2 GHz (CDMA 2000) antennas were deactivated in February 2009. They had an RF-EMF emission period of 11 months. The final removal of both the 0.8 and the 2 GHz antennas took place in August 2009. So there are two comparable time periods for comparing the symptoms before and after the residents' exposure to the 2 GHz radiation.

Figure 2 shows the chronological sequence from the erection of the base station to the removal of both sets of antennas and the timings of the medical examinations.

In January 2009, the first medical examinations and interviews with the inhabitants were carried out whilst the base station was fully operational. A second set of examinations was conducted in August 2009 after the removal of the base station. These examinations and interviews compared the health of 107 residents during the base station's operation and after its removal. The residents had no prior knowledge about possible adverse health effects of RF-EMFs.

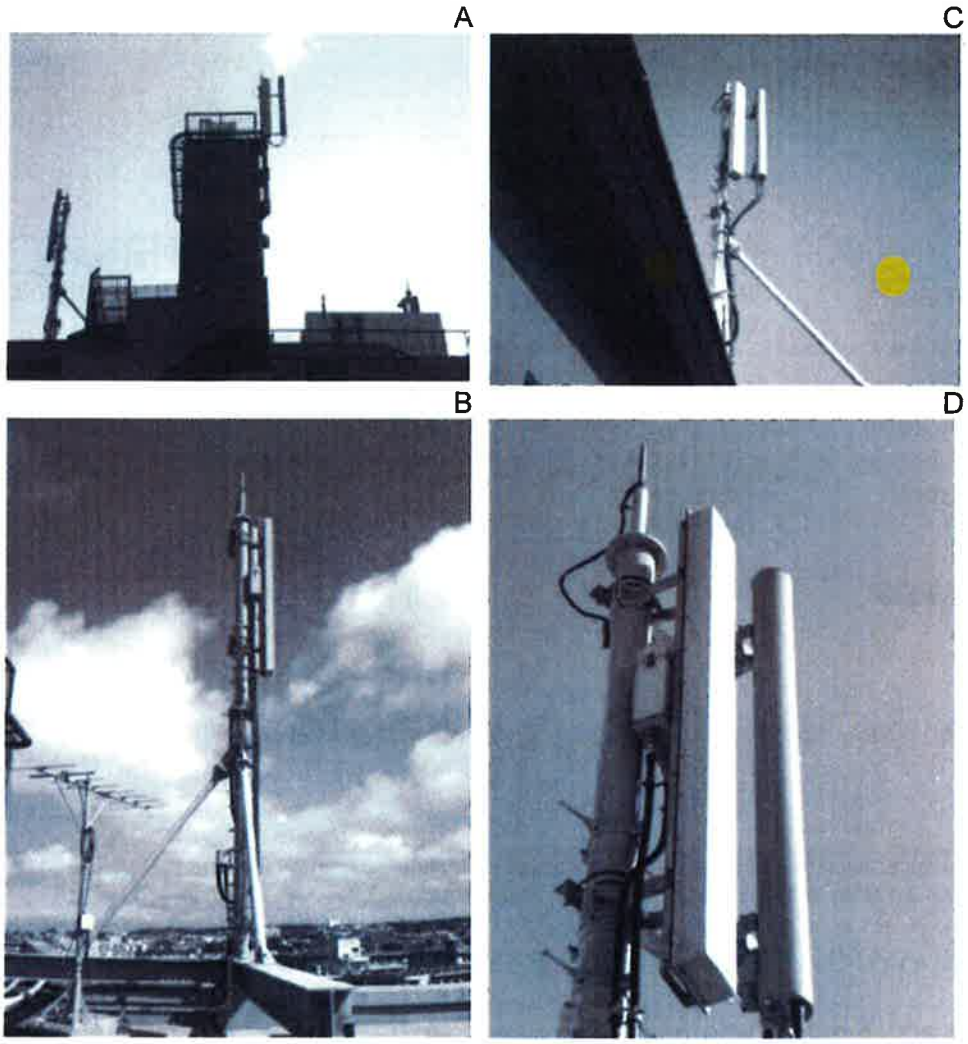


Figure 1: Close-up and overview photographs of the three transmitter masts on the roof of the condominium in Naha City, Okinawa, Japan. Each mast had an 800 MHz antenna and a 2 GHz antenna.
(A) Overview shot of all antennas, with corresponding housing for the base station's ancillary operational equipment.
(B) Antenna on the highest point of the building.
(C) View of the base stations from the balcony.
(D) Close-up of the 800 MHz (CDMA One) antennas and the 2 GHz (CDMA2000) antennas. The cylindrical antennas emit 2 GHz radiation, whereas the rectangular antennas emit 800 MHz radiation.

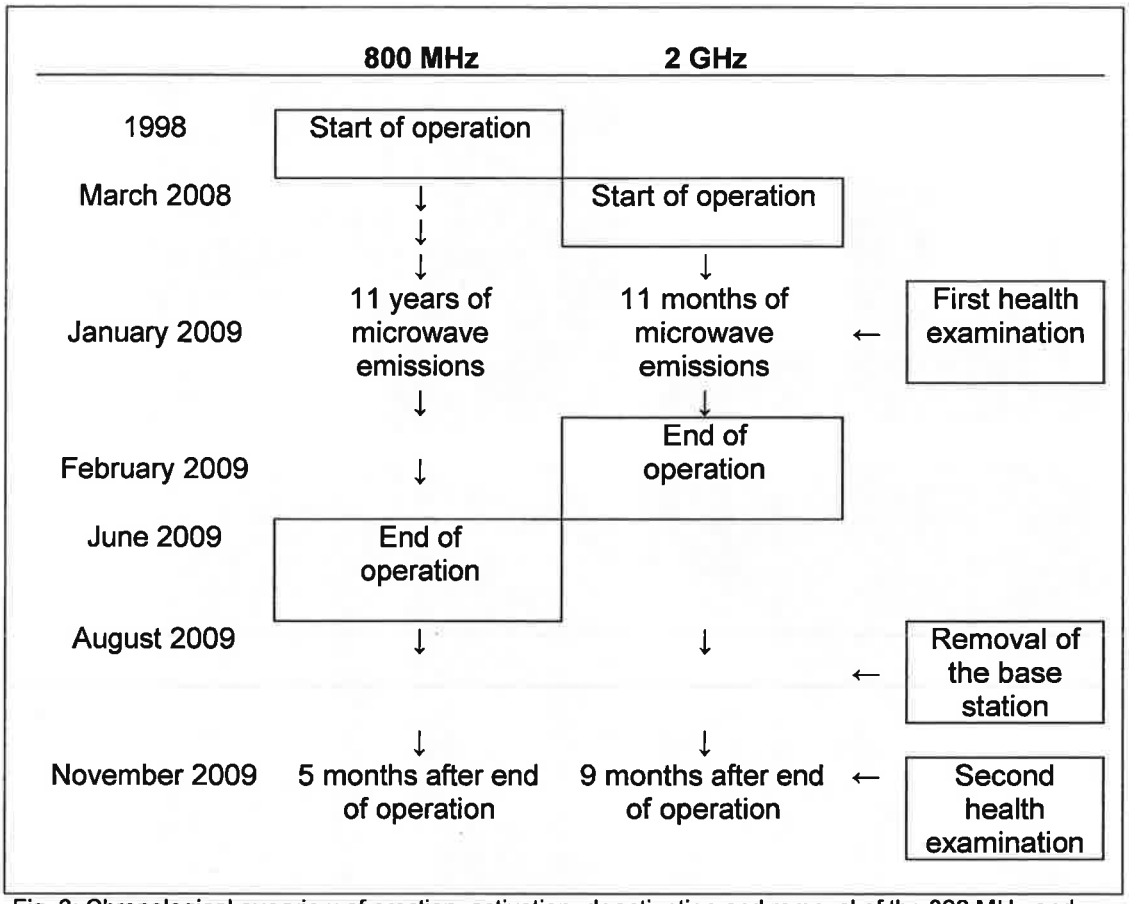


Fig. 2: Chronological overview of erection, activation, deactivation and removal of the 800 MHz and 2 GHz antennas together with the time of the health examinations.

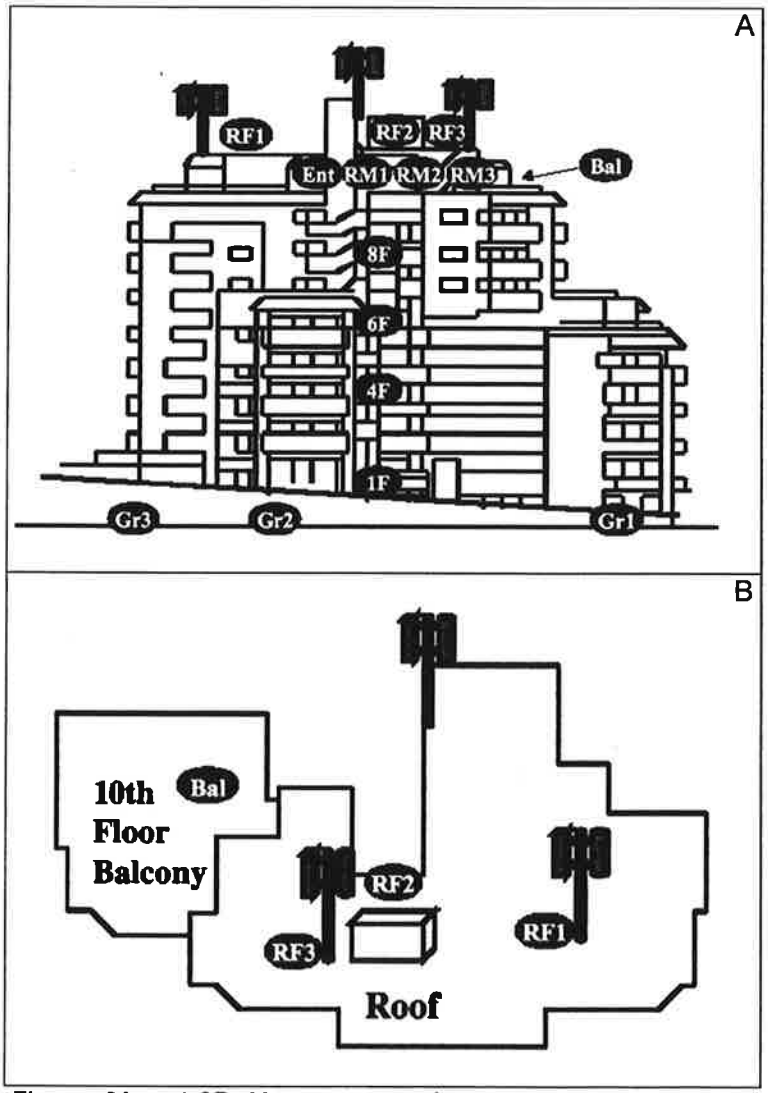
Examination of the Condominium Residents' Health Problems

A physician and a nurse, who had both more than 20 years of clinical experience, conducted face-to-face health examinations. Before the interviews, the residents had filled out health questionnaires distributed by the physician. Inhabitants of 39 out of 47 apartments participated. Vacant apartments and inhabitants who refused to participate were excluded from the study. 107 out of the 122 individuals who answered the questionnaires were interviewed. When interviewing the inhabitants about symptoms, the time of the first appearance of symptoms was taken into account. Health problems appearing between 1998 and March 2008, shortly before the installation of the 2 GHz antennas, were recorded as symptoms associated with radiation emitted from the 800 MHz antennas. Health problems appearing after the activation of the 2 GHz antennas, i.e. after March 2008 until the first examination in January 2009, were recorded as symptoms possibly affected by radiation emitted from the 2 GHz antennas.

Measurement of the Mobile Phone Base Station Power Density

After receiving a request from the condominium association board members, the mobile phone company operating the antennas undertook power density

measurements of the RF-EMFs emitted by the mobile phone base station. Two technicians employed by the mobile phone company conducted the measurements. The measuring device was an SRM-3000 (Narda Safety Test Solutions GmbH, Sandwiesenstrasse, Pfullingen, Germany). The technicians did not explain in detail to the residents how the measurements were taken. Figure 3 shows the 15 places where power density was measured. Three locations were assessed on the roof of the condominium and one on the balcony of the top (tenth) floor. Three rooms and the entrance area on that floor were also assessed, as were the entrance areas of rooms on the 8th, 6th, 4th, and 1st floor, the ground floor entrance area of the condominium and two locations within the parking lot. Before each measurement, the technicians called the operation centre. A few days later, the results of the measurements were sent to the board members of the condominium association.



Figures 3A and 3B: Measurement points used to assess the RF-EMFs emitted from the base station on 24th December 2008; elevation view (A) and plan view (B). For an explanation of the abbreviations used refer to Table 1.

Results of power density measurements taken to assess the RF-EMFs emitted by the base station			
Place of measurement		Power density (μW/cm^2) 2 GHz	800 MHz
Roof 1	(RF1)	0.01520	0.00336
Roof 2	(RF2)	0.00278	0.00029
Roof 3	(RF3)	0.02086	0.00258
Room 1 – 10th floor	(RM1)	0.00055	0.00028
Room 2 – 10th floor	(RM2)	0.00036	0.00031
Room 3 – 10th floor	(RM3)	0.00010	0.00060
Balcony – 10th floor	(Bal)	0.00316	0.00025
Entrance – 10th floor	(Ent)	0.00051	0.00016
8th floor	(8F)	0.00030	0.00060
6th floor	(6F)	0.00043	0.00051
4th floor	(4F)	0.00014	0.00093
1st floor	(1F)	0.00050	0.00014
Ground floor 1	(Gr1)	0.00074	0.00057
Ground floor 2	(Gr2)	0.00111	0.00011
Ground floor 3	(Gr3)	0.00246	0.00007

Table 1: Measurements taken at the locations shown in Figures 3A and 3B.

Results

Measurement of RF-EMF Emissions from the Mobile Phone Base Station

Two technicians from the mobile phone company measured the power densities at 15 different locations around the condominium to assess RF-EMF emissions from the mobile phone station on 24th December 2008 (Figures 3A and 3B). The RF-EMFs from the 800 MHz and 2 GHz antennas were measured and recorded separately. Table 1 shows the results of the measurements, which were between 0.0001 and 0.0286 μW/cm^2 (equivalent to 0.02 to 0.28 V/m).

The measurements taken at RF1 and RF3 indicated a relatively high power density. Interestingly, the power density measurements for the 2 GHz antennas showed lower values on the roof (RF2: 0.00278 μW/cm^2) than on the balcony (Bal: 0.00316 μW/cm^2). The distance between balcony and antenna was only slightly greater than the distance between RF2 and antenna. This result could be attributed to the fact that RF2 was behind the location of the base station's ancillary operational equipment.

	Frequency	Male	Female	Total
Number of residents		65	57	122
Number of respondents		56	51	107
Mean age of respondents		37.2	38.6	
(standard deviation)		(22.7)	(20.9)	
Mean exposure period	800 MHz	5.60	6.64	years
(standard deviation)		(3.10)	(2.92)	
	2 GHz	11	11	months

Table 2: Overview of the residents' age and gender distribution, as well as exposure time period.

Symptoms	Removal of the 800 MHz antennas		
	Before	After	P-value
Tinnitus	13	4	<0.05
Myodesopsia	7	2	>0.05
Arthralgia, shoulder stiffness	7	1	<0.05
Headache	5	1	>0.05
Hypertension	4	1	>0.05
Nasal bleeding	4	0	>0.05
Tumours (lymphoma, tongue cancer, bladder cancer)	3	1	>0.05
Insomnia, sleep problems, sleep disturbances	3	1	>0.05
Dizziness, vertigo	3	1	>0.05
Eye pain, ocular infection, dry eyes	3	0	>0.05
Astigmatism, deteriorated eyesight	2	0	>0.05
Palpitation (tachycardia), arrhythmia	2	0	>0.05
Tremor	1	1	>0.05
Glaucoma	1	0	>0.05
Hearing loss	1	0	>0.05
Rhinitis (nasal discharge)	1	0	>0.05
Otitis media	1	0	>0.05
Invertebral disc hernia	1	0	>0.05
Numbness	1	0	>0.05
Skin problems	1	0	>0.05
Angina pectoris	1	0	>0.05
Complex regional pain syndrome (CRPS)	1	0	>0.05
Total	**66**	**13**	

Table 3: Health comparison before and after the removal of the 800 MHz antennas. The statistical evaluation was carried out using Fisher's exact test and the chi-square test.
Symptoms appearing during the operation of both the 800 MHz antennas and the 2 GHz antennas are printed in bold letters.

Symptoms	Removal of the 2 GHz antennas		
	Before	After	P-value
Fatigue, loss of motivation	21	0	<0.01
Eye pain, ocular infection, dry eyes	14	0	<0.01
Insomnia, sleep problems, sleep disturbances	11	2	<0.01
Dizziness, vertigo, Menière's disease	11	0	<0.01
Jitteriness	11	0	<0.01
Astigmatism, deteriorated eyesight	10	6	>0.05
Headache	9	1	<0.01
Impaired consciousness	8	0	<0.01
Arthralgia, shoulder stiffness	7	3	>0.05
Tinnitus	7	1	<0.05
Nasal bleeding	6	0	<0.05
Palpitation (tachycardia), arrhythmia	5	2	>0.05
Numbness	5	0	<0.05
Dyspnoea, shortness of breath	3	1	>0.05
Tumours (colon polyp, vocal chord polyp)	3	0	>0.05
Skin problems	3	0	>0.05
Memory loss	3	0	>0.05
Hyperthyroidism and hypothyroidism	2	2	>0.05
Lack of concentration	2	0	>0.05
Hypertension	2	0	>0.05
Mental confusion	2	0	>0.05
Rhinitis (nasal discharge)	2	0	>0.05
Gastritis	2	0	>0.05
Cataract	1	0	>0.05
Angina pectoris	1	0	>0.05
Facial nerve palsy	1	0	>0.05
Facial flushing	1	0	>0.05
Sweating	1	0	>0.05
Taste disorder	1	0	>0.05
Hearing loss	1	0	>0.05
Slurred speech	1	0	>0.05
Drowsiness	1	0	>0.05
Total	**158**	**18**	

Table 4: Comparison of the symptoms appearing during and after operation of the 2 GHz antennas. The statistical evaluation was carried out using Fisher's exact test and the chi-square test. Symptoms appearing during the operation of both the 800 MHz antennas and the 2 GHz antennas are printed in bold letters.

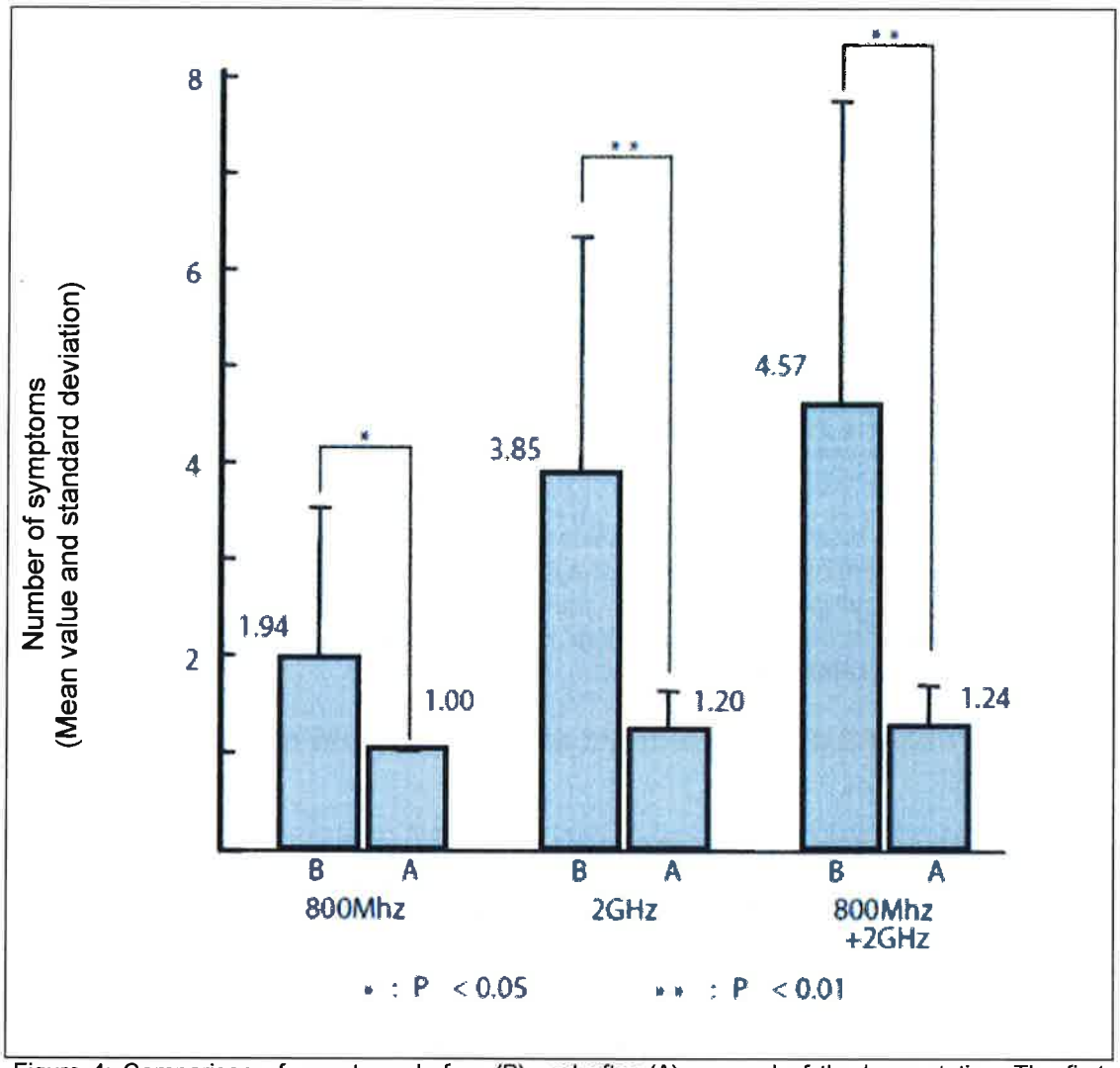


Figure 4: Comparison of symptoms before (B) and after (A) removal of the base station. The first examination (B) was conducted in January 2009 during antenna operation, the second (A) in November 2009 after removal of the base station. The Figure shows the average number of symptoms per inhabitant.

The pair of bars on the left refers to the symptoms appearing only during the operation of the 800 MHz antennas. The pair of bars in the centre refers to the time period from March 2008 to January 2009, when the 2 GHz base antennas were activated. The pair of bars on the right is the sum of both of those pairs of bars. The statistical evaluation was carried out using Student's t-test and analysis of covariance (ANCOVA).
* = P < 0.05, ** = P < 0.01.

Frequency	Base station removal		χ^2	P-Value	OR [95%CI]
	Before	After			
	N=107 (%)	N=107 (%)			
800 MHz	34 (31.8)	13 (12.1)	10.9	< 0.001	3.37 [1.67-6.78]
2 GHz	41 (38.3)	15 (14.0)	15.1	< 0.001	3.81 [1.96-7.40]
800 MHz + 2 GHz	49 (45.8)	25 (23.4)	10.9	< 0.001	2.77 [1.54-4.97]

Table 5: Statistical comparison of the number of inhabitants with health problems before and after base station removal using the chi-square test.

Subjects of the Health Examination

The health examinations were conducted twice – in January 2009 and in November 2009 – among 107 out of 122 residents. This represented a participation rate of 87.7 %. 56 participants were male and 51 female. The average age was 37.2 years for male and 38.6 years for female participants. The average time period of RF-EMF exposure from the 800 MHz antennas was 5.60 years for the males and 6.64 years for the females. Regarding the 2 GHz RF-EMF exposure, the average exposure period was 11 months for both male and female residents. Table 2 provides an overview of the residents' age and gender distributions, as well as the periods of exposure time.

Health problems of the residents after installation of the 800 MHz antennas

34 residents said they had health problems after the 800 MHz antennas had been installed. They mentioned 66 individual symptoms, which are listed in Table 3. The health problem symptoms included: tinnitus, myodesopsia, arthralgia, shoulder stiffness, headache, and nasal bleeding. For tinnitus and arthralgia, the difference was shown to be statistically significant.

Health problems of the residents after installation of the 2 GHz antennas

After installation of the 2 GHz antennas, 41 individuals showed symptoms. 26 of these 41 participants had already exhibited symptoms after installation of the 800 MHz antennas. The subjects mentioned a total of 158 cases of symptoms. These are documented in Table 4. The most frequent symptoms were fatigue and loss of motivation, eye pain, astigmatism, deteriorated eyesight, insomnia, sleep problems, sleep disturbances, dizziness, jitteriness, tachycardia, palpitation, numbness and others. The number of these symptoms – except for astigmatism, deteriorated eyesight, tachycardia, and palpitations – decreased significantly after the removal of the mobile phone station. The symptoms that were recognised during the operation of both the 800 MHz and the 2 GHz antennas are printed in bold font. Health problems that appeared after the installation of the 2 GHz antennas were greater in number than those appearing after installation of the 800 MHz antennas. A comparison of the number of symptoms before and after removal of the mobile phone base station shows significant differences.

Comparison of the number of residents with health problems before and after removal of the mobile phone base station

A total of 34 residents suffered from health problems after installation of the 800 MHz antennas. Three months after their removal this number decreased to 13. There were 41 residents who had health problems after installation of the 2 GHz antennas, and this number decreased to 15 after removal of the 2 GHz antennas. In total 49 residents suffered from health problems during operation of both the 800 MHz and the 2 GHz antennas. However, this number decreased to 25 after removal of both sets of antennas.

These results showed significant differences using the chi-square test (Table 5).

Discussion

The power density values read by the mobile phone company are extremely low, suspiciously low, compared with measurements taken near other base stations (Abdel-Rassoul et al. 2006). Furthermore, the power density was measured only once by the mobile phone company, whereas this kind of measurement should be conducted several times. Although the power density, as measured by the mobile phone company, was too low to be considered relevant in aggravating the health problems experienced by residents, we have used these measurements as reference levels in this case study.

The RF-EMF values were highest at RF1 and RF3, two locations adjacent to the antennas. The RF-EMF power density values at RF2 were lower. It is possible that RF2's location behind the shelter accounts for these lower values. The power density of Bal, the balcony on the 10th floor, was higher than the power density at RF2. Theoretically, the RF-EMFs emitted from the antennas are not directed vertically downwards. However, it is likely that RF-EMFs were emitted downwards in the form of a side lobe. The power density measurement values clearly indicated that the 2 GHz antennas gave off more energy than the 800 MHz antennas. The number of individual health problems the residents suffered from after installation of the 800 MHz antennas was 66, and rose to 158 after installation of the 2 GHz antennas. It is possible that the health problems the residents suffered from after installation of the 2 GHz antennas were related to their high power output.

This health investigation diagnosed 34 residents with health problems appearing during operation of the 800 MHz antennas; out of these residents, 26 suffered even worse health problems after the installation of the 2 GHz antennas. Considering the fact that these residents had already recognised their health problems as related to the 800 MHz antennas, they could possibly have become more sensitive to RF-EMFs emitted from the 2 GHz antennas. Hypersensitisation could have occurred among these residents. The incidence of health problems among 26 residents out of 34 is apparently more frequent than that of electromagnetic hypersensitivity (EHS) patients (Hillert et al. 2002, Johansson 2006, Kato & Johansson 2012, Levallois et al. 2002, Schreier et al. 2006, Schröttner & Leitgeb 2008).

Moreover, it is considered that the acute symptoms could have occurred whilst those residents were exposed to the higher energy of RF-EMFs emitted by the 2 GHz antennas.

Recent studies suggest that the pattern and angle of radiation emission, the effects of modulation and the power density all need to be taken into account. An experiment using baboons revealed that the melatonin concentration in the pineal gland decreased significantly while the baboons were exposed to different modulations of EMF in a sudden onset/offset environment (Rogers et al. 1995). Furthermore, a report examining the stress hormone levels of residents living close to a mobile phone base station showed that an abnormal amount of stress hormones was secreted over the period of one year (Buchner & Eger 2011). Because of such findings, it is important to conduct longitudinal studies on stress hormone secretion under the influence of RF-EMFs. Our research examines symptoms from the

installation of the 800 MHz RF-EMF emitting antennas up to the period after their removal, a total time of 11 years. Examining long-term changes of the residents' health problems has enabled us to prove that the residents' health showed significant differences before and after the removal of the mobile phone base station.

In 2000, the European Commission decided to adopt a precautionary approach as a basic principle in environmental issues. In this decision, the EU pledged to take precautionary measures to deal with environmental issues, so that irreversible consequences could be anticipated even if the risk was not scientifically proven European Union (2010). However, the Japanese Government has issued an Electromagnetic Wave Protection Guidance which states that RF-EMFs do not affect health if they are below 1000 μW/cm^2 in the 1800 MHz to 5 GHz frequency range. (MIC 2011). The value 800 MHz range permitted by the Japanese Government is 530 μW/cm2 calculated by the following formula: f (MHz)/1500 (between the frequency is 800 to 1500 MHz) (MIC 2000). As a result, an increasing number of mobile phone towers and base stations have been erected, without any regulation, on the roofs of condominium buildings. Moreover, media coverage of non-ionising radiation is in Japan much rarer than in Europe and the USA. Because of this, it is difficult for this issue to be recognised by the Japanese general public.

Summary

Our intention was to examine whether there were health impacts on residents from RF-EMFs emitted by the mobile phone base station erected on the roof of their condominium building. We conducted thorough research on whether there were any other factors to account for the improvements of the residents' health other than the removal of the base station.

The results of this case report indicate that health problems of the residents were associated with the operation of the mobile phone base station and that these problems improved after its removal. Although this report is not a double-blind study, it can be used as an example indicating the potential effects of RF-EMFs emitted from mobile phone base stations erected on the roofs of condominium buildings on human health. It is imperative that further detailed research is conducted regarding the impact of RF-EMFs on human health.

Note

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The Editor

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ARTICLE ACCEPTED AS A LETTER TO EDITOR IN « LA PRESSE MEDICALE » 10 SEPTEMBER 2001

Symptoms experienced by people living in the vicinity of cellular phone base stations: Influence of distance and sex

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The symptoms that result from the use of a mobile cellular phone are relatively well known (1,2,3). By contrast, no investigation exists concerning the health of those living in the vicinity of mobile phone base stations.

The results presented below analyze, in their entirety, 530 questionnaires received from people in France living in proximity to base stations. The participants in the investigation specified their distance from the base stations as: 19.6 % of the subjects lived less than 10 meters away; 26.2% lived between 10 and 50 meters away; 13.8% lived between 50 and 100 meters away; 9.6% lived between 100 and 200 meters away; 10.1% lived between 200 and 300 meters away, and 20.7% lived at more than 300 meters away or were not exposed to base stations. They estimated the intensity of their symptoms using this scale: Never = 0; Sometimes = 1; Often = 2; Very Often = 3.

The statistical study (CHI SQUARE test with YATES correction) shows the frequency of symptoms of an intensity of 2 and 3 as a function of distance from the base station. As frame of reference, the comparison was made with the group of participants farthest away (distance >300m) or found beyond the operation of base stations (no base stations or non-operational base stations).

The table clearly shows:

a. The existence of certain complaints (nausea, loss of appetite, visual disturbances, movement difficulties) of significant differences ($p<0.05$) solely within a zone very close to base stations (less than **10 m**) and not beyond that.

b. The fact that for other symptoms, a significant rise in the frequency of complaints ($p<0.05$) was observed up to a distance of **100 m** (irritability, depressive tendency, loss of memory, dizziness) – **200 m** (headaches, sleep disturbance, feeling of discomfort, skin problems) – indeed **300 m** (fatigue).

In terms of these results and in application of the precautionary principle, it is recommended that base stations not be sited less than 300 meters from residences, particularly in the case of locations where populations are found that are physiologically more fragile (day care centers, schools, retirement homes, hospitals . . .).

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ENGLISH TITLE: - Symptoms experienced by people in vicinity of cellular phone base stations.

KEY WORDS : - Base station – Bioeffects.

Symptoms	Distances from base stations in meters (m)											
	< 10 m		10 à 50 m		50 à 100 m		100 à 200 m		200 à 300 m		> 300 m ...	
	2	3	2	3	2	3	2	3	2	3	2	3
Fatigue	76 *	72 *	63.5*	50.9*	60.6	56.6*	64.2	41.1	66.6*	43.7	40.7	27.2
Irritability	32.8	23.2*	41.7*	25.7*	47.2*	44.1*	25.8	4.1	25	9	18	3.3
Headaches	51 *	47.8*	40 *	26.1*	40.6*	36.7*	60.7*	31.2*	19.3	0	15.6	1.8
Nausea	14.5*	6.9	8.4	3	5.7	3.8	2.4	4,6	0	2.3	2,1	1.1
Loss of Appetite	20.4*	8.3	8	5.5	5	5	6.9	0	4.2	0	3.3	3.3
Sleep Disturbance	41.3*	57.1*	41.4*	57.5*	46.9*	58.5*	45.8*	50*	33.3	35.5	13.8	21.1
Depressive Tendency	16,9	26.8*	21.6	19.7*	11.6	24 *	16.2	3.1	13.6	2.5	10.3	3.7
Feeling of Discomfort	28 *	45.4*	25.2*	18.9	30.6*	12.8	15.7*	0	9.7	5.1	2.4	8.1
Difficulty in concentration	39.3	28.8*	37.5	16.6	34.2	26.4*	25	12.5	43.3	5.5	26.7	7.1
Loss of Memory	27.8	25.4*	29.4	26.6*	37.1*	29 *	25	15.6	17.2	11.1	17.9	5.8
Skin Problems	18.1*	17.1*	6.6	10.8	11.1*	11.1	13.9*	7.5	8.7	0	1.2	4.6
Visual Disruptions	14.5	24.3*	23	13.5	22	7.1	2.5	4.9	15	2.8	13.6	4.1
Hearing Disruptions	33.3*	17.4	17.7*	12	8.3	15.5	7.7	7.7	11.6	9.5	5.6	8.7
Dizziness	10	12.5*	17.3*	7,5*	9.6	9.6*	12.2	2.7	7.7	5.2	6.2	0
Movement Difficulties	5.6	7.7*	8.2	1.7	3	3	0	0	2	0	2.9	1
Cardio-vascular Problems	10.1*	13 *	15.3*	9.6	12.3*	7.4	8.7	0	8.5	6.5	1	3

Table 1 : - Percentages of complaints reported by those living in the vicinity of base stations as a function of their distance away for the base station..

* = Significant difference ($p < 0.05$) in comparison to reference (control) subjects found at > 300 m or not exposed, for the reponses 2 = « often » and 3 = « very often»

Symptoms	Men (%)	Women (%)
Fatigue	41.4	57.5
Irritability	17.9	28.3
Headaches	14.4	45.6 *
Nausea	0	5.9 *
Loss of appetite	1.9	8 *
Sleep disturbance	45.4	61 *
Depreswsive tendencies	9.8	26.7 *
Feeling of discomfort	15	25.4 *
Difficulties in concentration	18.4	21.6
Memory loss	18	27.7
Skin problems	8	13.1
Visual disturbances	12.2	22 *
Hearing disturbances	9.6	19
Dizziness	6	9.8
Movement difficulties	3.3	2.7
Cardio-vascualr problems	8.3	8.8
Lowering of libido	18	12

Table 2 : - Influence of sex on the frequency of reported symptoms by subjects (270 men, 260 women) living in the vicinity (all distances less than 300 m) of mobile phone base stations..

* = $p < 0.05$

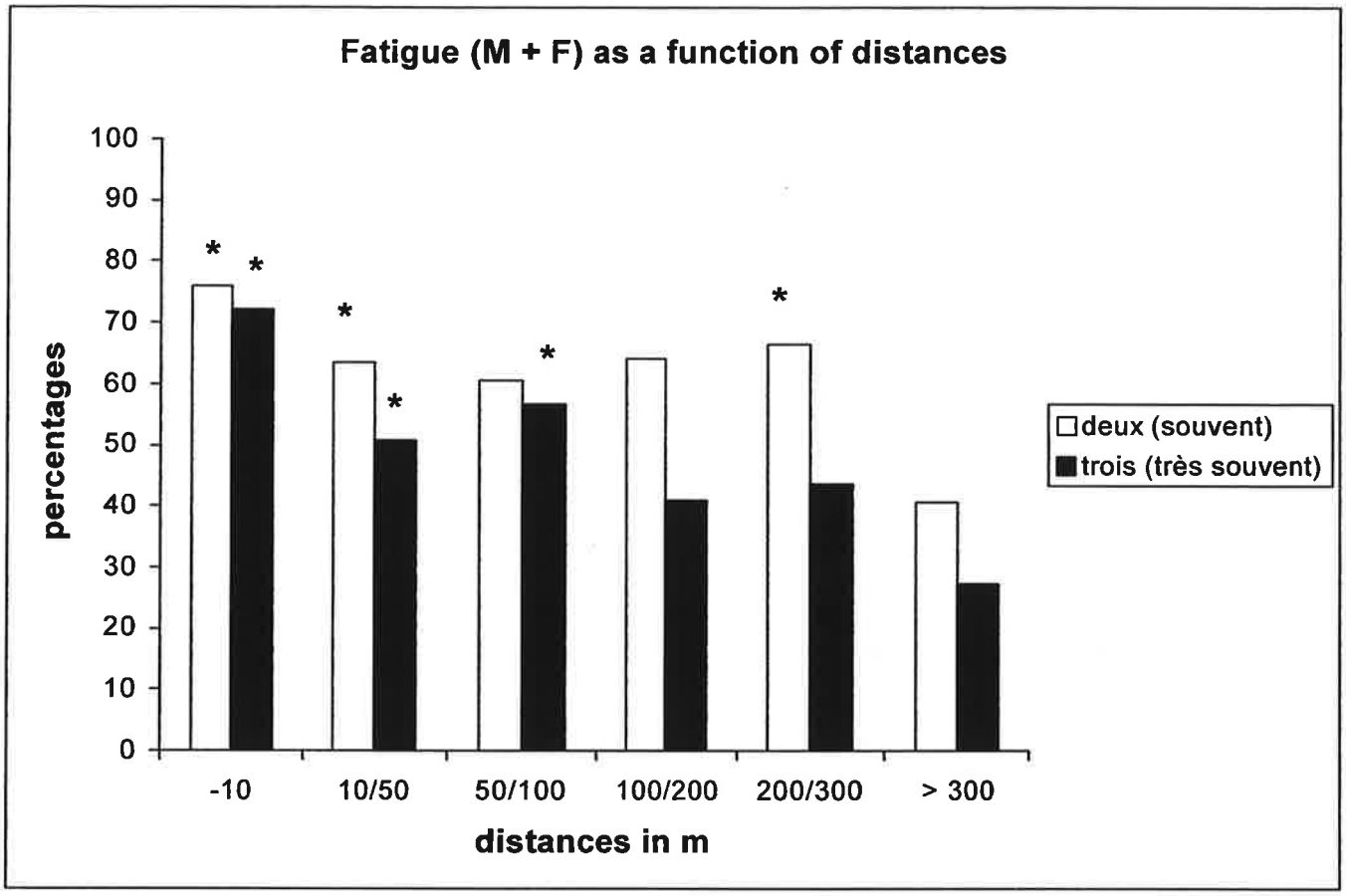

Figure 1 : - frequency of complaints of fatigue, in people living in the vicinity of mobile phone base stations as a function of their distance from base stations.

M = Males - F = Females – m = meters

deux (souvent) = two (often) - trois (tres souvent) = three (very often)

* = $p < 0.05$ (comparison with the subjects at a distance > 300 m or not exposed)

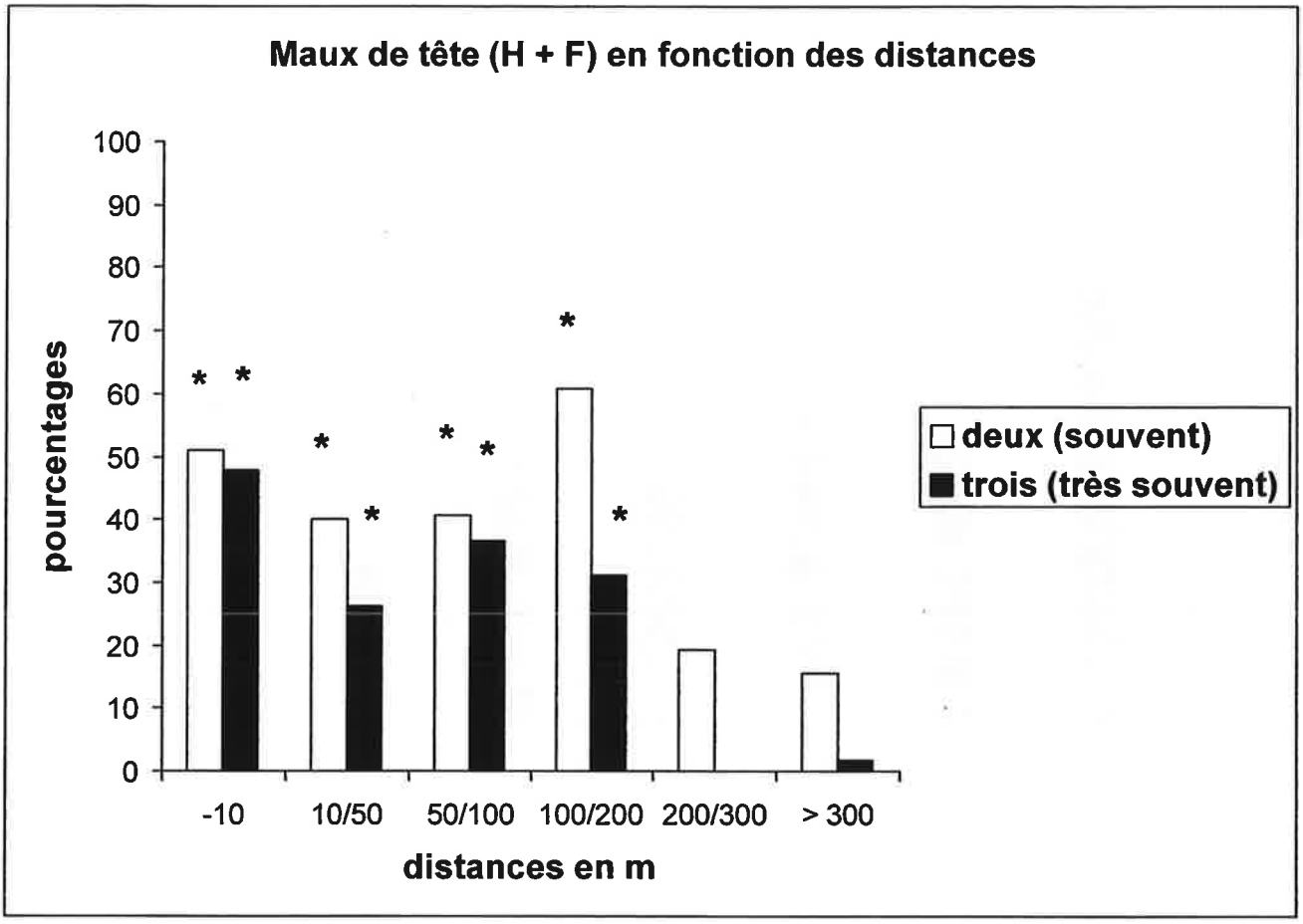

Figure 2 : - Frequency of headache complaints experienced by subjects as a function of their distance from base stations.

H – hommes = Men F – femmes = Women m = mètres = meters

* = $p < 0.05$ (comparison with subjects at distance > 300 m or not exposed).

SYMPTOMS EXPERIENCED BY PEOPLE IN VICINITY OF BASE STATION: *INFLUENCE OF DISTANCE AND SEX*

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SUMMARY

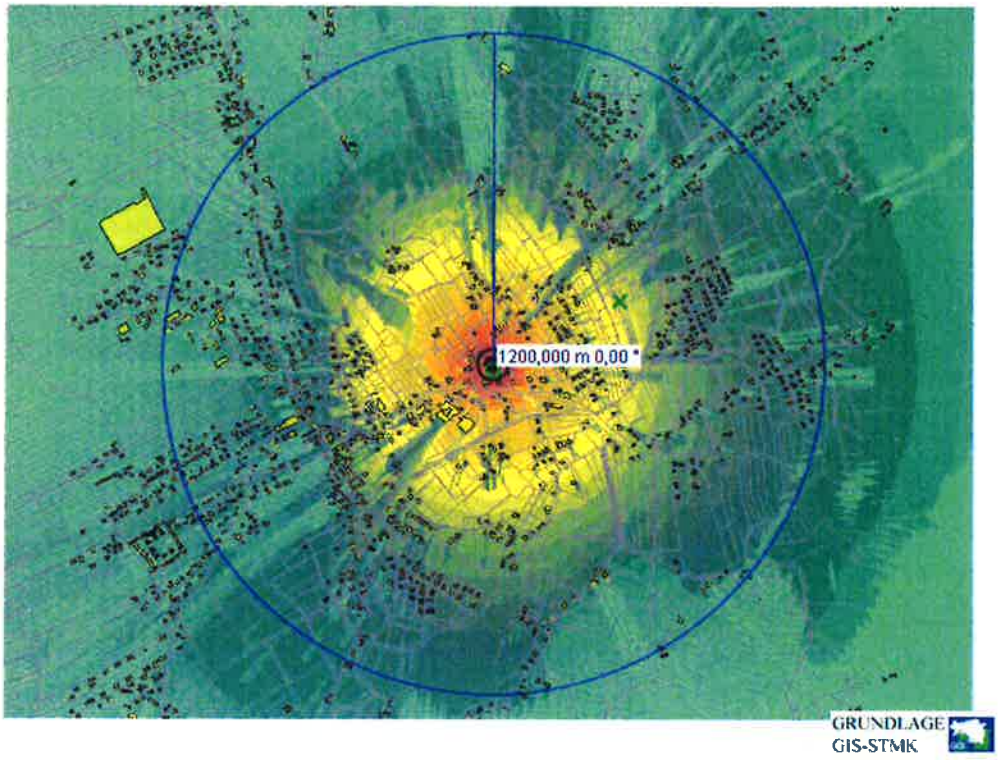
A survey study, using a questionnaire, was conducted on 530 people (270 men, 260 women) living or not in vicinity of cellular phone base stations, on 18 Non-Specific Health Symptoms. Comparisons of frequency of complaints (CHI-SQUARE test with Yates correction) in relation to distance from base station and sex, show significant ($p < 0.05$) increases as compared to people living > 300 m or not exposed to base station, up to a distance of 300 m for fatigue, 200 m for headache, sleep disturbance, discomfort, ... 100 m for irritability, depression, loss of memory, dizziness, libido decrease, ...

Women complained significantly more often than men ($p < 0.05$) of headache, nausea, loss of appetite, sleep disturbances, depression, discomfort and visual disturbances.

This first study of symptoms experienced by people living in vicinity of base stations shows that, in view of radiofrequency radiation protection, minimal distance of residences from cellular phone base stations should not be < 300 m.the

KEY WORDS: - Base station – Cellular phone – Bioeffects.

Environmental Epidemiological Study of Cancer Incidence in the Municipalities of Hausmannstätten & Vasoldsberg (Austria)



English Executive Summary

Translation by Katharina Gustavs

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Dr. Gerd Oberfeld

Das Land Steiermark
→ Gesundheitsressort

Environmental Epidemiological Study of Cancer Incidence in the Municipalities of Hausmannstätten & Vasoldsberg (Austria)

Commissioned by

Provincial Government of Styria,

Department 8B, Provincial Public Health Office, Graz (Austria)

Conducted by

Dr. Gerd Oberfeld, Salzburg (Austria)

20 January 2008

Executive Summary

It was the study's objective to determine whether cancer cases that became known in the eastern part of Hausmannstätten or Vasoldsberg, respectively, represent a cluster with regard to timing and location as well as whether they might be associated with the mobile phone base station, which operated as a car phone service from 1984 to 1997. The analog mobile phone base station under study was part of the national C-Network, installed by the Austrian post and communications authority and operated according to the Nordic Mobile Telephone 450 (NMT 450) standard. The cell radii of this network were usually up to 30 km.

The area under study was defined as a circle with a 1,200-m radius around the former transmitter. With the help of the provincial government of Styria (GIS Steiermark) and the municipalities of Hausmannstätten and Vasoldsberg, n=2,543 potential study participants could be located and personally invited to participate in the study. By applying limiting exposure conditions such as the assumption of a latency period, an "after-effect period" and a 5-year minimum exposure period, three different case-control samples were compiled. Sample A (67 cases/1242 controls) and B (67 cases/646 controls) included living and deceased cases, sample C (28 cases/56 controls) living cases only.

Based on the selected exposure period limits, the distance assessment for the range from 0 to 200 m around the transmitter in comparison to the area from 201 to 1,200 m showed a significantly increased cancer risk for all three samples, which makes for a distinct incidence with regard to location. The incidence was particularly pronounced for breast and brain tumors.

The exposure assessment with regard to the analog transmitter (NMT450) was conducted on an individual basis for all three samples (A, B, C), using calculations based on NIRView and CORLA software products. Taking into account the antenna characteristics, natural terrain and built environment, the transmitter input power was based on 25 watts for a continuously

transmitting calling channel. The respective power density level was determined for a total of 1,309 individuals.

It was a question whether to determine the exposure level of a continuously transmitting calling channel only or the calling channel plus (probably) three traffic channels. From a precautionary point of view, the exclusive consideration of the calling channel is desirable, which was done in this assessment.

Furthermore, 25 m to the east of the original transmitter site (NMT450), a simulated transmitter was installed with the same antenna height (8 m above ground) and the actively transmitting test signal (434.2 MHz) was measured at the selected frequency in the bedrooms of 84 study participants (sample C only). In addition, participants of this sample also answered an extensive questionnaire on cancer risk factors and protective factors in a personal interview. The analysis of this data revealed that these factors could not explain the local incidence we found or the relationship with the RF radiation exposure.

The essential assessment focused on the relationships between the RF radiation exposure levels from the transmitter and cancer risk. The risk (odds ratio=OR) was assessed for the exposure categories 10-100 $\mu W/m^2$, 100-1000 $\mu W/m^2$ and greater than 1000 $\mu W/m^2$ (1 mW/m^2) in relation to the reference category less than 10 $\mu W/m^2$, all of which apply to outdoor levels.

For all models, the analysis revealed significantly increased risk ratios. Compared to the reference category (<10 $\mu W/m^2$), the cancer risk for all cancer sites in the highest exposure category (>1000 $\mu W/m^2$) was 5 to 8 times higher, depending on the sample. Similar to the distance assessment, the cancer cases were again most pronounced for the cancer sites breast and brain.

In comparison to the reference category (<10 $\mu W/m^2$), the cancer risk in the highest exposure category (>1000 $\mu W/m^2$) of sample A was 23 times higher for breast cancer and 121 times higher for brain tumors. For all three endpoints under study (all sites, breast, brain) significant exposure-effect relationships (p for the trend) were observed.

Detailed results for sample A are summarized in the chapter below, called "Summary of the Risk Calculations for Sample A". With its higher number of controls, sample A has an advantage over sample B because its statistical power is slightly higher. In addition, sample-A participants are taken mainly from the registry and therefore rather independent of their willingness to participate.

In summary, based on the selected exposure period limits, the study showed a significant cancer incidence with regard to timing and location in the area around the transmitter as well as significant exposure-effect relationships between RF radiation exposure and the incidence of breast cancers and brain tumors.

This case-control study is the first worldwide to investigate the relationship between cancer risk and a mobile phone base station by means of a special calculation software as well as historically simulated measurements. For various reasons, the study of NMT base stations makes sense. For example, the antenna characteristics are adequately known. Generally speaking, all that is required to simulate exposure levels is information about the site and the antenna height. Furthermore, in the exposure time period from 1984 to 1997, RF radiation exposures were still rather straightforward, a fact that makes the research on health impacts from these new technologies increasingly more difficult.

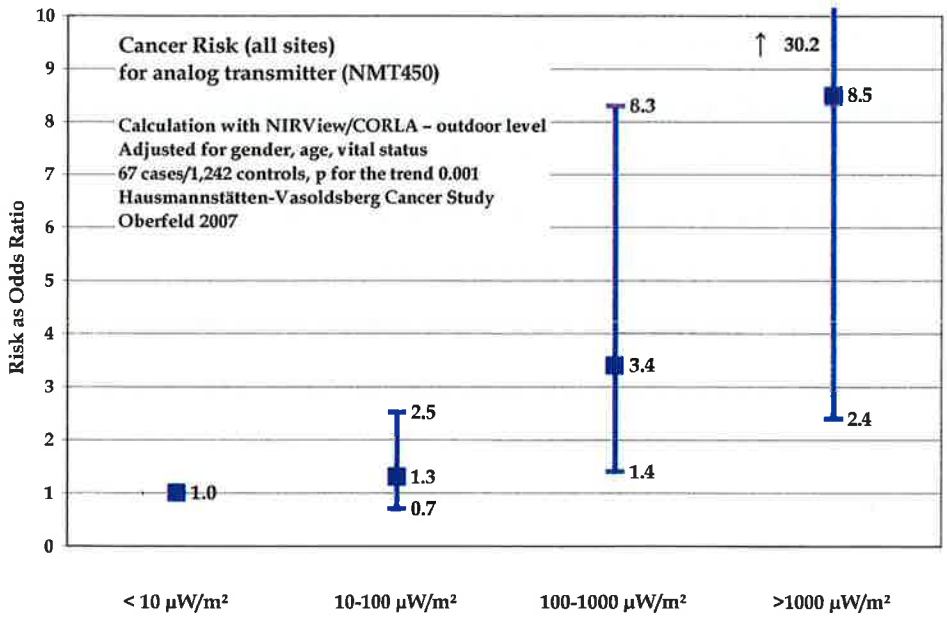
Summary of Risk Calculations for Sample A

In the tables and graphs below, the results of the multivariate risk calculations for sample A adjusted for age, gender and vital status can be found.

All Cancer Sites

Exposure (outdoor)	Controls	Cases	OR	95 % CI	p-value	p-trend
<10 µW/m²	837	39	1.0	-	-	0.001
10-100 µW/m²	313	17	1.3	0.7-2.5	0.454	
100-1000 µW/m²	76	7	3.4	1.4-8.3	0.008	
>1000 µW/m²	16	4	8.5	2.4-30.2	0.001	

Table 1: Sample A – All Cancer Sites: Results of logistic regression for exposure variables (exposure calculation - outdoor) adjusted for age, gender and vital status. Exposure-effect relationship

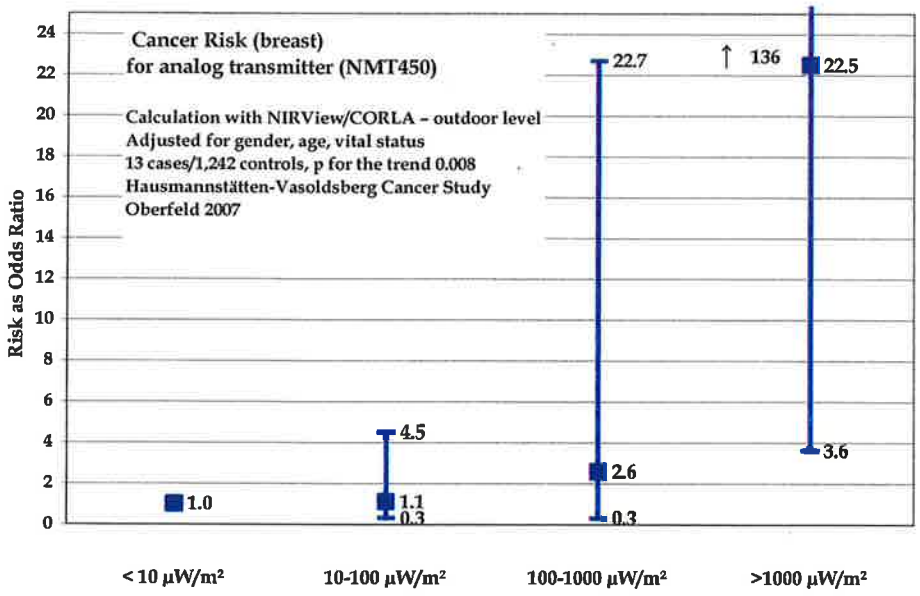


Graph 1: Sample A – All Cancer Sites: Results of logistic regression for exposure variables (exposure calculation - outdoor) adjusted for age, gender and vital status. Exposure-effect relationship

Cancer Site: Breast

Exposure (outdoor)	Controls	Cases	OR	95 % CI	p-value	p-trend
<10 µW/m²	837	7	1.0	-	-	0.008
10-100 µW/m²	313	3	1.1	0.3-4.5	0.881	
100-1000 µW/m²	76	1	2.6	0.3-22.7	0.394	
>1000 µW/m²	16	2	22.5	3.6-136.6	0.0007	

Table 2: Sample A – Cancer Site Breast: Results of logistic regression for exposure variables (exposure calculation - outdoor) adjusted for age, gender and vital status. Exposure-effect relationship

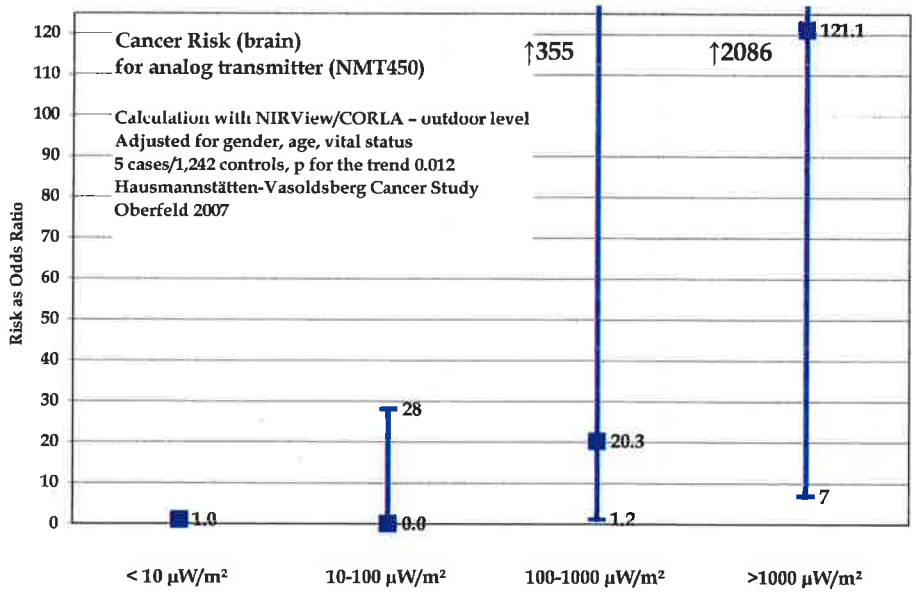


Graph 2: Sample A – Cancer Site Breast: Results of logistic regression for exposure variables (exposure calculation - outdoor) adjusted for age, gender and vital status. Exposure-effect relationship

Cancer Site: Brain

Exposure (outdoor)	Controls	Cases	OR	95 % CI	p-Wert	p-trend
<10 µW/m²	837	1	1.0	-	-	0.012
10-100 µW/m²	313	0	0.0	0.0-2E+28	0.867	
100-1000 µW/m²	76	2	20.3	1.2-355.2	0.039	
>1000 µW/m²	16	2	121.1	7.0-2086.0	0.001	

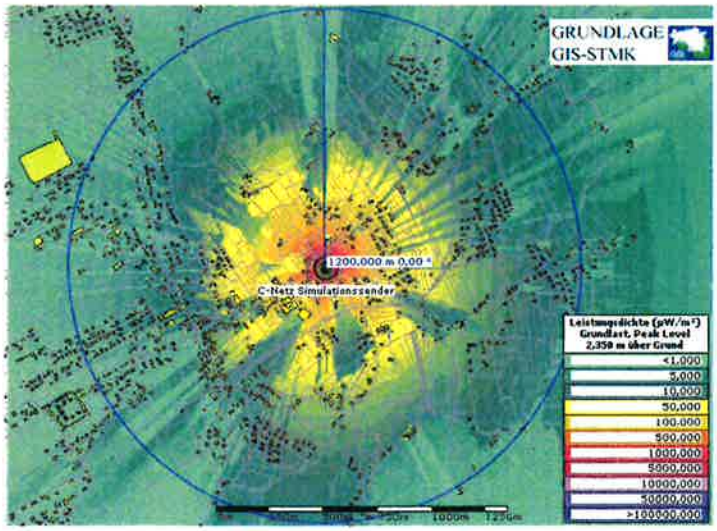
Table 3: Sample A – Cancer Site Brain: Results of the logistic regression for exposure variables (exposure calculation - outdoor) adjusted for age, gender and vital status. Exposure-effect relationship



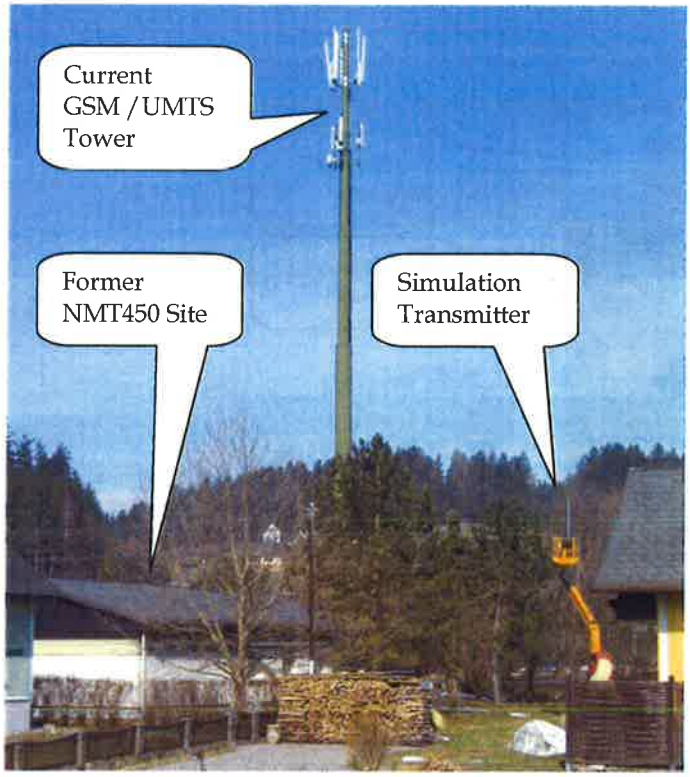
Graph 3: Sample A – Cancer Site Brain: Results of logistic regression for exposure variables (exposure calculation - outdoor) adjusted for age, gender and vital status. Exposure-effect relationship

Illustrations

Right Side of the Picture: Telephone Exchange Center with C-Network Transceiver (NMT 450), 8071 Hausmannstätten, Property No. 865, KG Hausmannstätten, 1994. Source: W. Sabutsch.



Immission Calculation – CORLA (Building Model) for C-Network Transmitter at the 2.35-m Layer above Ground, data basis GIS-STMK.



General View of Former Roof Site of NMT450 (C-Network) Telephone Exchange Center, Site of Simulated C-Network Transmitter and Current Mobile Phone Tower GSM/UMTS, March 2006

Simulated C-Network Transmitter Installed at Mobile Stacking Truck, March 2006

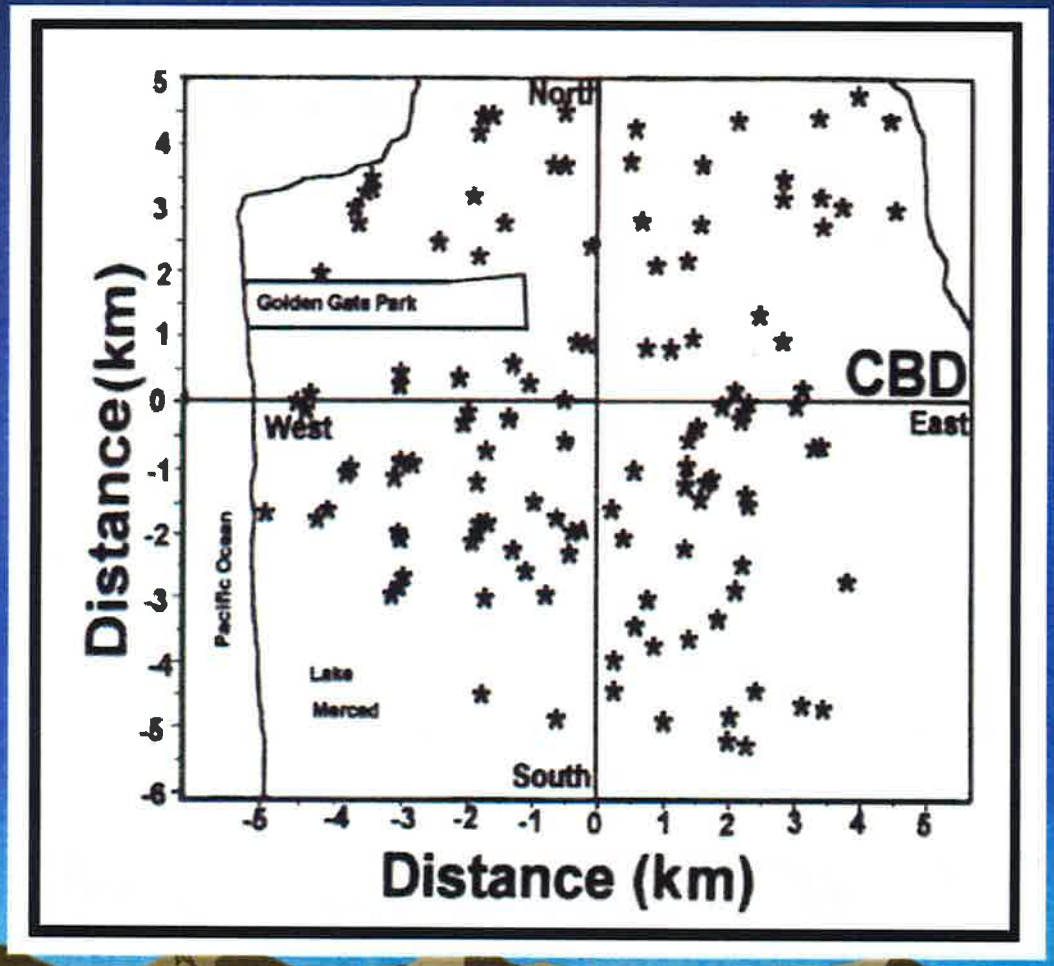
EMF from RF/Cell towers

What we can learn from Neil Cherry's Sutro Tower research

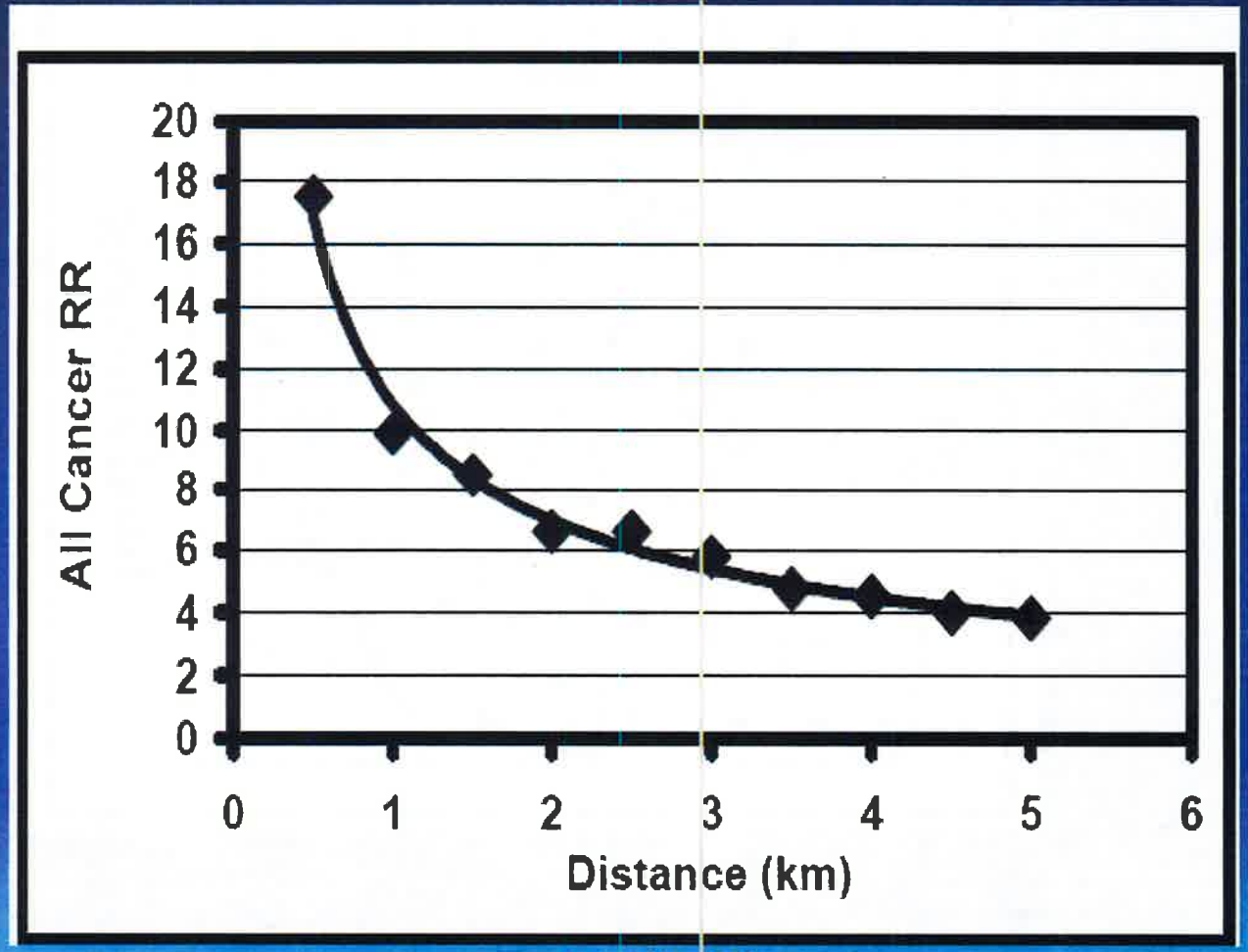
Cherry's Sutro Tower study

- From 1973-1988 the Sutro tower was the primary source of RF radiation in San Francisco.
- The study looked at the spatial distribution of 123 cases of white childhood cancer in the 50,000 children (age<21) in the area.
- Radiated power from Sutro Tower=18.3 MW

Spatial map of white childhood cancer for San Francisco 1973-88. The Sutro tower is at the intersection of the n-s and e-w lines.

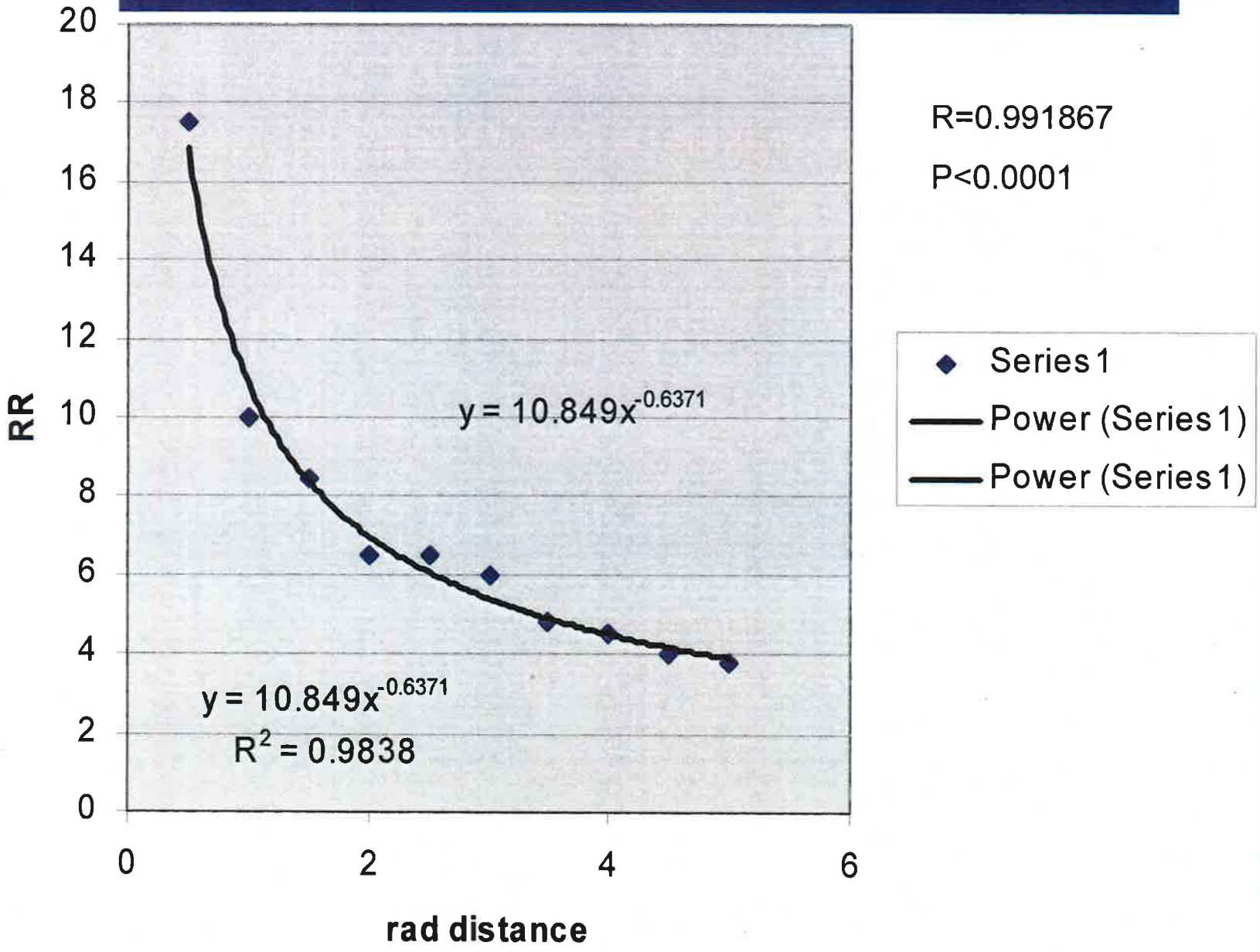


Radial Cumulative All Cancer for Childhood Cancer in 0.5 Km radial segments around the Sutro tower. P<0.0001



RR=relative risk=measured cancer /Expected incidence (population norm) RR=1 means no added risk. RR=18 means an 18 fold increased incidence of cancer. Even 5 Km away from tower, note the 4 fold increase in cancer

Best Curve fit- Power function
$Y=RR=10.849\ X^{-0.6371}$



Finding Border of Hazard Zone

(using $Y=RR=10.849\ X^{-0.6371}$)

- How far does the effect extend?

Setting RR=1.1 (10% increased risk) gives radial distance of 36 Km

Setting RR=1.01 (1% increased risk) gives radial distance of 41 Km

Conclusion: Hazard zone extends about 40 Km from the 18.3 MegaWatt RF transmitter

Finding edge of hazard zones for lower power transmitters

- The Power density at distance D from a transmitter satisfies:

Power density~Transmitter power/D^2

To find the safe distance from a 1 Watt Smart Meter

$$\frac{18.3\ MW}{(40Km)^2} = \frac{1\ Watt}{D^2}$$ gives D=9.35 meters (30 feet)

As the Smart meter transmits directly at us, while the radio transmitter points above our head, add a factor of 2 for the **smart meter: 60 feet safety zone.**

(Factor of 2 is verified on next page)

Verifying the factor of 2:

- In the youtube video Dark Side of Smart Meters, Rob States shows the level of radiation 3 feet from the smart meters is approximately equal to the radiation levels 2 Km from the Sutro tower.
- Multiplying by 20, the radiation levels 60 feet from the Smart Meter should be approximately equal to the levels 40 Km from the Sutro tower, which is where the hazard zone ends.
- So one should stay at least 60 feet from the smart meter to be safe. (92 feet is even safer)

Finding edge of hazard zones for lower power transmitters

- The Power density at distance D from a transmitter satisfies:

Power density~Transmitter power/D^2

To find safe distance from a 100 Watt radio transmitter

$$\frac{18.3\ MW}{(40Km)^2} = \frac{100\ Watt}{D^2}$$ gives D=93.55 meters

Here we do not need to multiply by an extra factor as we are comparing one radio transmitter to another

References

- Link To Neil Cherry's paper

Childhood Cancer in the Vicinity of the Sutro Tower, San Francisco

For a more complete presentation on Smart Meters and the Sutro Tower research, see Youtube: Dark Side of Smart Meters, by electrical Engineer Rob States

features

The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods

by Sandy Bond, PhD, and Ko-Kang Wang

abstract

This article examines whether proximity to cellular phone towers has an impact on residential property values and the extent of any impact. First, a survey approach is used to examine how residents perceive living near cellular phone base stations (CPBSs) and how residents evaluate the impacts of CPBSs. Next, a market study attempts to confirm the perceived value impacts reported in the survey by analyzing actual property sales data. A multiple regression analysis in a hedonic pricing framework is used to measure the price impact of proximity to CPBSs. Both the survey and market sales analysis find that CPBSs have a negative impact on the prices of houses in the study areas.

The introduction of cellular phone systems and the rapid increase in the number of users of cellular phones have increased exposure to electromagnetic fields (EMFs). Health consequences of long-term use of cellular phones are not known in detail, but available data indicates that development of nonspecific health symptoms is possible.[1] Conversely, it appears health effects from cellular phone equipment (antennas and base stations) pose few, if any, known health hazards.[2]

A concern associated with cellular phone usage is the siting of cellular phone transmitting antennas (CPTAs) and cellular phone base stations (CPBSs). In New Zealand, CPBS sites are increasingly in demand as the major cellular phone companies there, Telecom and Vodafone, upgrade and extend their network coverage. This demand could provide the owner of a well-located property a yearly income for the siting of a CPBS.[3] However, new technology that represents potential hazards to human health and safety may cause property values to diminish due to public perceptions of hazards. Media attention to the potential health hazards of CPBSs has spread concerns among the public, resulting in increased resistance to CPBS sites.

Some studies suggest a positive correlation between long-term exposure to the electromagnetic fields and certain types of cancer,[4] yet other studies report inconclusive results on health effects.[5] Notwithstanding the research results, media reports indicate that the extent of opposition from some property owners

1. Stanislaw Szmigielski and Elizbieta Sobiczewska, "Cellular Phone Systems and Human Health—Problems with Risk Perception and Communication," *Environmental Management and Health* 11, no. 4 (2000): 352–368.
2. Jerry R. Barnes, "Cellular Phones: Are They Safe?" *Professional Safety* 44, no. 12 (Dec. 1999): 20–23.
3. R. Williams, "Phone Zone—Renting Roof Space to Ma Bell," *The Property Business* 12 (April 2001): 6–7.
4. C. M. Krause et al., "Effects of Electromagnetic Field Emitted by Cellular Phones on the EEG During a Memory Task," *Neuroreport* 11, no. 4 (2000): 761–764.
5. Independent Expert Group on Mobile Phones, *Mobile Phones and Health* (Report to the United Kingdom Government, 2000), http://www.iegmp.org.uk.

affected by the siting of CPBSs remains strong.[6] However, the extent to which such attitudes are reflected in lower property values for homes located near CPBSs is not known.

Understanding the impact of CPBSs on property values is important to telecommunications companies both for planning the siting of CPBSs and for determining likely opposition from property owners. Similarly, property appraisers need to understand the valuation implications of CPBSs when valuing CPBS-affected property. The owners of affected property also want to understand the magnitude of any effects, particularly if compensation claims or an award for damages are to be made based on any negative effects on value.

The research here uses a case study approach to determine residents' perceptions towards living near CPBSs in Christchurch, New Zealand, and to quantify these effects in monetary terms according to an increasing or decreasing percentage of property value. The case study uses both an opinion survey and an econometric analysis of sales transaction data. A comparison of the results can be used to help appraisers value affected property as well as to resolve compensation issues and damage claims in a quantitative way. Further, the results provide a potential source of information for government agencies in assessing the necessity for increased information pertaining to CPBSs.

The following provides a brief review of the cellular phone technology and relevant literature. Then, the next section describes the research procedure used, including descriptions of the case study and control areas. The results are then discussed, and the final section provides a summary and conclusion.

Cellular Telephone Technology[7]

Cellular (mobile) telephones are sophisticated two-way radios that use ultrahigh frequency (UHF) radio waves to communicate information. The information is passed between a mobile phone and a network of low-powered transceivers, called mobile phone sites or cell sites. As mobile sites are very low powered they serve only a limited geographic area (or "cell"), varying from a few hundred meters to several kilometers; they can handle only a limited number of calls at one time. When a mobile phone user on the move leaves one cell and enters another, the next site automatically takes over the call, allowing contact to be maintained.

When a mobile phone call is initiated, the phone connects to the network by using radio signals to communicate with the nearest mobile phone site. The mobile phone sites in a network are interlinked by cable or microwave beam, enabling phone calls to be passed from one cell to another automatically. A mobile phone site is typically made up of a mast with antennas connected to equipment stored in a cabinet. Power is fed into the cabinet by underground cable. The antennas are designed to transmit most of the signal away horizontally, or just below horizontal, rather than at steep angles to the ground.

Mobile phone sites can only accommodate a limited number of calls at any one time. When this limit is reached, the mobile phone signal is transferred to the next nearest site. If this site is full or is too far away, the call will fail.

Cell site capacity is a major issue for telecommunication companies. As the number of people using mobile phones grows, more and more cell sites are required to meet customer demand for reliable coverage. At the end of March 2002, Telecom had more than 1.3 million mobile phone customers and more than 750 mobile phone sites throughout New Zealand. Vodafone had over 1.1 million mobile phone customers.[8] In areas, such as Auckland (the largest city in New Zealand, with close to a third of the NZ population), where almost complete coverage has been achieved, the main issue is ensuring that there is the capacity to handle the ever-increasing number of mobile phones and calls.

Locating Cellular Phone Sites

For cellular phone service providers, the main goals when locating cell sites are (1) finding a site that provides the best possible coverage in the area without causing interference with other cells, and (2) finding a site that causes the least amount of environmental impact on the surrounding area. Service providers usually attempt to locate cell sites on existing structures such as buildings, where antennas can be mounted on the roof to minimize the environmental impact. If this is not possible, a mast will need to be erected to support the antennas for the new cell site.

6. S. Fox, "Cell Phone Antenna Worries Family," *East & Bays Courier,* November 8, 2002, 1.
7. The information in this section was sourced from Telecom, http://www.telecom.co.nz; New Zealand Ministry for the Environment, http://www.mfe.govt.nz; and New Zealand Ministry of Health, http://www.moh.govt.nz.
8. Vodafone, "Cell Sites and the Environment," http://www.vodafone.co.nz/aboutus/vdfn_about_cellsites.pdf (accessed December 19, 2002) and "Mobile Phones and Health," http://www.vodafone.co.nz/aboutus/vdfn_about_health_and_safety.pdf (accessed December 19, 2002); and Telecom, "Mobile Phone Sites and Safety," http://www.telecom.co.nz/content/0,3900,27116-1536,00.html (accessed December 19, 2002).

Service providers prefer to locate cell sites in commercial or industrial areas due to the "resource consent" procedure required by the Resource Management Act 1991[9] for towers located in residential areas.

Despite the high level of demand for better cell phone coverage, the location of cell sites continues to be a contentious issue. The majority of people want better cell phone coverage where they live and work, but they do not want a site in their neighborhood. Thus, cell sites in or near residential areas are of particular concern. Concerns expressed usually relate to health, property values, and visual impact.[10]

In general, uncertainties in the assessment of health risks from base stations are presented and distributed in reports by organized groups of residents who protest against siting of base stations. When the media publishes these reports it amplifies the negative bias and raises public concerns. According to Covello, this leads to incorrect assessment of risks and threats by the public, with a tendency to overestimate risks from base stations and neglect risks from the use of cell phones.[11]

Assessment of Environmental Effects

Under the Resource Management Act 1991 (RMA), an assessment of environmental effects is required every time an application for resource consent is made. Information that must be provided includes "an assessment of any actual or potential effects that the activity may have on the environment, and the ways in which any adverse effects may be mitigated."[12] An assessment of the environmental effects of cell sites would take into consideration such things as health and safety effects; visual effects; effects on the neighborhood; and interference with radio and television reception.

Radio Frequency and Microwave Emissions from CPBSs

According to the Ministry for the Environment, the factors that affect exposure to radiation are as follows:

- Distance. Increasing the distance from the emitting source decreases the radiation's strength and decreases the exposure.
- Transmitter power. The stronger the transmitter, the higher the exposure.
- Directionality of the antenna. Increasing the amount of antennas pointing in a particular direction increases the transmitting power and increases the exposure.
- Height of the antenna above the ground. Increasing the height of an antenna increases the distance from the antenna and decreases the exposure.
- Local terrain. Increasing the intervening ridgelines decreases the exposure.[13]

The amount of radiofrequency power absorbed by the body (the dose) is measured in watts per kilogram, known as the specific absorption rate (SAR). The SAR depends on the power density in watts per square meter. The radio frequencies from cellular phone systems travel in a "line of sight." The antennas are designed to radiate energy horizontally so that only small amounts of radio frequencies are directed down to the ground. The greatest exposures are in front of the antenna so that near the base of these towers, exposure is minimal. Further, power density from the transmitter decreases rapidly as it moves away from the antenna. However, it should be noted that by initially walking away from the base, the exposure rises and then decreases again. The initial increase in exposure corresponds to the point where the lobe from the antenna beam intersects the ground.[14]

Health Effects

According to Szmigielski and Sobiczewska, the analogue phone system (using the 800–900 megahertz band) and digital phone system (using the 1850–1990 megahertz band) expose humans to electromagnetic field (EMF) emissions: radio frequency radiation (RF) and microwave radiation (MW), respectively. These two radiations are emitted from both cellular phones and CPBSs.[15]

For years cellular phone companies have assured the public that cell phones are safe. They state that the particular set of radiation parameters associated with cell phones is the same as any other ra-

9. The Resource Management Act 1991 is the core of the legislation intended to help achieve sustainability in New Zealand; see http://www.mfe.govt.nz/laws/rma.

10. Szmigielski and Sobiczewska; and Barnes.

11. Vincent T. Covello, "Risk Perception, Risk Communication, and EMF Exposure: Tools and Techniques for Communicating Risk Information," in *Risk Perception, Risk Communication and Its Application to EMF Exposure: Proceedings of the World Health Organization and ICNIRP Conference,* ed. R. Matthes, J. H. Bernhardt, M. H. Repucholi, 179–214 (Munich, Germany, May 1998).

12. Section 88(4), (b), Resource Management Act 1991.

13. Ministry for the Environment and Ministry of Health, *National Guidelines for Managing the Effects of Radiofrequency Transmitters,* available at http://www.mfe.govt.nz and http://www.moh.govt.nz (accessed May 21, 2002).

14. Ibid.; and Szmigielski and Sobiczewska.

15. Szmigielski and Sobiczewska.

dio signal. However, reported scientific evidence challenges this view and shows that cell phone radiation causes various effects, such as altered brain activity, memory loss, and fatigue.[16]

According to Cherry, there is also strong evidence to conclude that cell sites are risk factors for certain types of cancer, heart disease, neurological symptoms and other effects.[17] The main concerns related to EMF emissions from CPBSs are linked to the fact that radio frequency fields penetrate exposed tissues.

Public concern regarding both cell phones and CPBSs in many countries has led to establishment of independent expert groups to carry out detailed reviews of the research literature. Research on the health effects of exposures to RF are reviewed by, for instance, the NZ Radiation Laboratory, the World Health Organization, the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the Royal Society of Canada, and the UK Independent Expert Group on Mobile Phones. The reviews conclude that there are no clearly established health effects for low levels of exposure. Such exposures typically occur in publicly accessible areas around radio frequency transmitters. However, there are questions over the delayed effects of exposure.

While present medical and epidemiological studies reveal weak association between health effects and low-level exposures of RF/MW fields, controversy remains among scientists, producers, and the general public. Negative media attention has fuelled the perception of uncertainty over the health effects from cell phone systems. Further scientific or technological information is needed to allay fears of the public about cell phone systems.

Radio Frequency Radiation Exposure Standards

International Standards. The reviews of research on the health effects of exposures to RF have helped establish exposure standards that limit RF exposures to a safe level. Most standards–including those set by the ICNIRP, the American National Standards Institute (ANSI), and New Zealand–are based on the most-adverse potential effects.

The 1998 ICNIRP guidelines have been accepted by the world's scientific and health communities; these guidelines are both consistent with other stated standards and published by a highly respected and independent scientific organization. The ICNIRP is responsible for providing guidance and advice on the health hazards of nonionizing radiation for the World Health Organization (WHO) and the International Labour Office.[18]

The New Zealand Standard. In New Zealand, when a mobile phone site is being planned, radio frequency engineers calculate the level of electromagnetic energy (EME) that will be emitted by the site. The level of EME is predicted by taking into account factors such as power output, cable loss, antenna gain, path loss, and height and distance from the antenna. These calculations allow engineers to determine the maximum possible emissions in a worst-case scenario, i.e., as if the site was operated at maximum power all the time. The aim is to ensure that EME levels are below international and NZ standards in areas where the general public has unrestricted access.

All mobile phone sites in New Zealand must comply in all respects with the NZ standard for radio frequency exposures.[19] This standard is the same as used in most European countries, and is more stringent than that used in the United States, Canada, and Japan. Some local communities in New Zealand have even lower exposure-level standards; however, in reality mobile phone sites only operate at a fraction of the level set by the NZ standard. The National Radiation Laboratory has measured exposures around many operating cell sites, and maximum exposures in publicly accessible areas around the great majority of sites are less than 1% of the exposure limit of the NZ standard. Exposures are rarely more than a few percent of the limit, and none have been above 10%.

Court Decisions

Two court cases in New Zealand have alleged adverse effects due to CPBSs: *McIntyre v. Christchurch City*

16. K. Mann and J. Röschke, "Effects of Pulsed High-Frequency Electromagnetic Fields on Human Sleep," *Neuropsychobiology* 33, no. 1 (1996): 41–47; Krause et al.; Alexander Borbely et al., "Pulsed High-Frequency Electromagnetic Field Affects Human Sleep and Sleep Electroencephalogram," *Neurosci Let*, 275, no. 3 (1999): 207–210; L. Kellenyi et al., "Effects of Mobile GSM Radiotelephone Exposure on the Auditory Brainstem Response (ABR)," *Neurobiology* 7, no. 1 (1999): 79–81; B. Hocking, "Preliminary Report: Symptoms Associated with Mobile Phone Use," *Occup Med* 48, no. 6 (Sept. 1998): 357–360; and others as reported in Neil Cherry, *Health Effects Associated with Mobil Base Stations in Communities: The Need for Health Studies*, Environmental Management and Design Division, Lincoln University (June 8, 2000); http://pages.britishlibrary.net/orange/cherryonbasestations.htm.

17. Cherry.

18. Ministry for the Environment and Ministry of Health.

19. NZS 2772.1:1999, "Radiofrequency Fields Part I: Maximum Exposure Levels – 3kHz to 300GHz." This standard was based largely on the 1998 ICNIRP recommendations for maximum human exposure levels to radio frequency. The standard also includes a requirement for minimizing radio frequency exposure. See National Radiation Laboratory, *Cell Sites* (March 2001), 7; available at http://www.nrl.moh.govt.nz/CellsiteBooklet.pdf.

Council[20] and *Shirley Primary School v. Telecom Mobile Communications Ltd.*[21] Very few cell site cases have actually proceeded to Environment Court hearings. In these two cases the plaintiffs claimed that there was a risk of adverse health effects from radio frequency radiation emitted from cell phone base stations and that the CPBSs had adverse visual effects.

In *McIntyre*, Bell South applied for resource consent to erect a CPBS. The activity was a noncomplying activity under the Transitional District Plan. Residents objected to the application. Their objections were related to the harmful health effects from radio frequency radiation. In particular, they argued it would be an error of law to decide, based on the present state of scientific knowledge, that there are no harmful health effects from low-level radio frequency exposure. It was also argued that the Resource Management Act contains a precautionary policy and also requires a consent authority to consider potential effects of low probability but high impact in reviewing an application.

The Planning Tribunal considered residents' objections and heard experts' opinions as to the potential health effects, and granted the consent, subject to conditions. It was found that there would be no adverse health effects from low levels of radiation from the proposed transmitter, not even effects of low probability but high potential impact.

In *Shirley Primary School*, Telecom applied to the Christchurch City Council for resource consent to establish, operate, and maintain a CPBS on land adjacent to the Shirley Primary School. This activity was a noncomplying activity under the Transitional District Plan. Again, the city council granted the consent subject to conditions. However, the school appealed the decision, alleging the following four adverse effects:

- Risk of adverse health effects from the radio frequency radiation emitted from the cell site
- Adverse psychological effects on pupils and teachers because of the perceived health risks
- Adverse visual effects
- Reduced financial viability of the school if pupils withdraw because of the perceived adverse health effects

The court concluded that the risk of the children or teachers at the school developing leukemia or other cancers from radio frequency radiation emitted by the cell site is extremely low, and the risk to the pupils of developing sleep disorders or learning disabilities because of exposure to radio frequency radiation is higher, but still very small. Accordingly, the Telecom proposal was allowed to proceed.

In summary, the Environmental Court ruled that there are no established adverse health effects from the emission of radio waves from CPBSs and no epidemiological evidence to show this. The court was persuaded by the ICNIRP guidelines that risk of health effects from low-level exposure is very low and that the cell phone frequency imposed by the NZ standard is safe, being almost two and one-half times lower than that of the ICNIRP.

The court did concede that while there are no proven health effects, there was evidence of property values being affected by both of the health allegations. The court suggested that such a reduction in property values should not be counted as a separate adverse effect from, for example, adverse visual or amenities effects. That is, a reduction in property values is not an environmental effect in itself; it is merely evidence, in monetary terms, of the other adverse effects noted.

In a third case, *Goldfinch v. Auckland City Council*,[22] the Planning Tribunal considered evidence on potential losses in value of the properties of objectors to a proposal for the siting of a CPBS. The court concluded that the valuer's monetary assessments support and reflect the adverse effects of the CPBS. Further, it concluded that the effects are more than just minor as the CPBS stood upon the immediately neighboring property.

Literature Review

While experimental and epidemiological studies have focused on the adverse health effects of radiation from the use of cell phones and CPBSs, few studies have been conducted to ascertain the impact of CPBSs on property values. Further, little evidence of property value effects has been provided by the courts. Thus, the extent to which opposition from property owners affected by the siting of CPBSs is reflected in lower property values is not well known in New Zealand.

Two studies have been conducted to ascertain the adverse health and visual effects of CPBSs on property values. Telecom commissioned Knight Frank (NZ) Ltd to undertake a study in Auckland in 1998/

20. NZRMA 289 (1996).
21. NZRMA 66 (1999).
22. NZRMA 97 (1996).

99 and commissioned Telfer Young (Canterbury) Ltd to undertake a similar study in Christchurch in 2001. Although the studies show that there is not a statistically significant effect on property prices where CPBSs are present,[25] the research in both cases involves only limited sales data analysis. Further, no surveys of residents' perceptions were undertaken, and the studies did not examine media attention to the sites and the impact this may have on saleability of properties in close proximity to CPBSs. Finally, as the sponsoring party to the research was a telecommunication company it is questionable whether the results are completely free from bias. Hence, the present study aims to help fill the research void on this contentious topic in an objective way.

CPBSs are very similar structures to high-voltage overhead transmission lines (HVOTLs); therefore it is worthwhile to review the body of literature on the property values effects of HVOTLs. The only recently published study in New Zealand on HVOTLs effects is by Bond and Hopkins.[24] Their research consists of both a regression analysis of residential property transaction data and an opinion survey to determine the attitudes and reactions of property owners in the study area toward living close to HVOTLs and pylons.

The results of the sales analysis indicate that having a pylon close to a particular property is statistically significant and has a negative effect of 20% at 10–15 meters from the pylon, decreasing to 5% at 50 meters. This effect diminishes to a negligible amount after 100 meters. However, the presence of a transmission line in the case study area has a minimal effect and is not a statistically significant factor in the sale prices.

The attitudinal study results indicate that nearly two-thirds of the respondents have negative feelings about the HVOTLs. Proximity to HVOTLs determines the degree of negativity: respondents living closer to the HVOTLs expressed more negative feelings towards them than those living farther away. It appears, however, from a comparison of the results, that the negative feelings expressed are often not reflected in the prices paid for such properties.

There have been a number of HVOTLs studies carried out in the United States and Canada. A major review and analysis of the literature by Kroll and Priestley indicates that in about half the studies, HVOTLs have not affected property values and in the rest of the studies there is a loss in property value between 2%–10%.[25] Kroll and Priestley are generally critical of most valuer-type studies because of the small number of properties included and the failure to use econometric techniques such as multiple regression analysis. They identify the Colwell study as one of the more careful and systematic analyses of residential impacts.[26] That study, carried out in Illinois, finds that the strongest effect of HVOTLs is within the first 15 meters, but the effect dissipates quickly with distance, disappearing beyond 60 meters.

A Canadian study by Des Rosiers, using a sample of 507 single-family house sales, finds that severe visual encumbrance due to a direct view of either a pylon or lines exerts a significant, negative impact on property values; however location adjacent to a transmission corridor may increase value.[27] This was particularly evident where the transmission corridor was on a well-wooded, 90-meter right-of-way. The proximity advantages include enlarged visual field and increased privacy. The decrease in value from the visual impact of the HVOTLs and pylons (on average between 5% and 10% of mean house value) tends to be cancelled out by the increase in value from proximity to the easement.

A study by Wolverton and Bottemiller[28] uses a paired-sale analysis of home sales in 1989–1992 to ascertain any difference in sale price between properties abutting rights-of-way of transmission lines (subjects) in Portland, Oregon; Vancouver, Washington; and Seattle, Washington; and those located in the same cities but not abutting transmission line rights-of-way (comparisons). Subjects sold during the study period were selected first; then a matching comparison was selected that was as similar to the subject as possible. The study results did not support a finding of a price effect from abutting an HVTL right-of-way. In their conclusion, the authors

23. Mark Dunbar, Telfer Young research valuer, personal communication with Bond, 2002. The results of these studies have not been made publicly known. The study by Knight Frank of Auckland was conducted by Robert Albrecht.

24. S. G. Bond and J. Hopkins, "The Impact of Transmission Lines on Residential Property Values: Results of a Case Study in a Suburb of Wellington, New Zealand," *Pacific Rim Property Research Journal* 6, no. 2 (2000): 52–60.

25. C. Kroll and T. Priestley, "The Effects of Overhead Transmission Lines on Property Values: A Review and Analysis of the Literature," Edison Electric Institute (July 1992).

26. Peter F. Colwell, "Power Lines and Land Value," *Journal of Real Estate Research* 5, no. 1 (Spring 1990): 117–127.

27. François Des Rosiers, "Power Lines, Visual Encumbrance and House Values: A Microspatial Approach to Impact Measurement," *Journal of Real Estate Research* 23, no. 3 (2002): 275–301.

28. Marvin L. Wolverton and Steven C. Bottemiller, "Further Analysis of Transmission Line Impact on Residential Property Values," *The Appraisal Journal* (July 2003): 244–252.

warn that the results cannot and should not be generalized outside of the data. They explain that

> limits on generalizations are a universal problem for real property sale data because analysis is constrained to properties that sell and sold properties are never a randomly drawn representative sample. Hence, generalizations must rely on the weight of evidence from numerous studies, samples, and locations.[29]

Thus, despite the varying results reported in the literature on property value effects from HVOTLs, each study adds to the growing body of evidence and knowledge on this (and similar) valuation issue(s). The study reported here is one such study.

Opinion Survey Research Objectives and Methodology

Research by Abelson;[30] Chalmers and Roehr;[31] Kinnard, Geckler and Dickey;[32] Bond;[33] and Flynn et al.,[34] recommend the use of market sales analysis in tandem with opinion survey studies to measure the impact of environmental hazards on residential property values. The use of more than one approach provides the opportunity to compare the results from each and to derive a more informed conclusion than obtained from relying solely on one approach. Thus, the methods selected for this study include a public opinion survey and a hedonic house price approach (as proposed by Freeman[35] and Rosen[36]). A comparison of the results from both of these techniques will reveal the extent to which the market reacts to cell phone towers.

Public Opinion Survey

An opinion survey was conducted to investigate the current perceptions of residents towards living near CPBSs and how this proximity might affect property values. Case study areas in the city of Christchurch were selected for this study. The study included residents in ten suburbs: five case study areas (within 300 meters of a cell phone tower) and five control areas (over 1 kilometer from the cell phone tower). The five case study suburbs were matched with five control suburbs that had similar living environments (in socioeconomic terms) except for the presence of a CPBS.

The number of respondents to be surveyed (800) and the nature of the data to be gathered (perceptions/personal feelings towards CPBSs) governed the choice of a self-administered questionnaire as the most appropriate collection technique. Questionnaires were mailed to residents living in the case study and control areas.

A self-administered survey helps to avoid interviewer bias and to increase the chances of an honest reply where the respondent is not influenced by the presence of an interviewer. Also, mail surveys provide the time for respondents to reflect on the questions and answer these at their leisure, without feeling pressured by the time constraints of an interview. In this way, there is a better chance of a thoughtful and accurate reply.

The greatest limitation of mail surveys is that a low response rate is typical. Various techniques were used to help overcome this limitation, including careful questionnaire design; inclusion of a free-post return envelope; an accompanying letter ensuring anonymity; and reminder letters. An overall response rate of 46% was achieved for this study.

The questionnaire contained 43 individual response items. The first question acted as an identifier to determine whether the respondent was a homeowner or tenant. While responses from both groups were of interest, the former was of greater importance, as they are the group of purchasers/sellers that primarily influence the value of property. However, it was considered relevant to survey both groups as both are affected by proximity to a CPBS to much the same extent from an occupiers' perspective, i.e., they both may perceive risks associated with a CPBS. It was hypothesized that tenants, being less-permanent residents, would perceive the effects in a similar way, but to a much lesser degree.

Other survey questions related to overall neighborhood environmental desirability; the timing of

29. Ibid., 252.

30. P. W. Abelson, "Property Prices and Amenity Values," *Journal of Environmental Economics and Management* 6 (1979): 11–28.

31. James A. Chalmers and Scott Roehr, "Issues in the Valuation of Contaminated Property," *The Appraisal Journal* (January 1993): 28–41.

32. W. N., Kinnard, M. B. Geckler, and S. A. Dickey, "Fear (as a Measure of Damages) Strikes Out: Two Case Studies Comparisons of Actual Market Behaviour with Opinion Survey Research" (paper presented at the Tenth Annual American Real Estate Society Conference, Santa Barbara, California, April 1994).

33. S. G. Bond, "Do Market Perceptions Affect Market Prices? A Case of a Remediated Contaminated Site," in *Real Estate Valuation Theory*, ed. K. Wang and M. L. Wolverton, 285–321 (Boston: Kluwer Academic Publishers, 2002).

34. James Flynn et al., "Survey Approach for Demonstrating Stigma Effects in Property Value Litigation," *The Appraisal Journal* (Winter 2004): 35–45.

35. A. Myrick Freeman, *The Benefits of Environmental Improvement: Theory and Practice* (Baltimore: John Hopkins Press, 1979).

36. Sherwin Rosen, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy* 82, no. 1 (Jan/Feb 1974): 34–55.

the CPBS's construction and its proximity in relation to the respondent's home; the importance placed on the CPBS as a factor in relocation decisions and on the price/rent the respondent was prepared to pay for the house; how a CPBS might affect the price the respondent would be willing to pay for the property; and the degree of concern regarding the effects of CPBSs on health, stigma, aesthetics, and property values. The surveys were coded to identify the property address of the respondent. This enabled each respondent's property to be located on a map and to show this in relation to the cell site.

Eighty questionnaires[37] were distributed to each of the ten suburbs (five case study and five control areas) in Christchurch. Respondents were instructed to complete the survey and return it in the free-post, self-addressed envelope provided. The initial response rate was 31%. A month later, a further 575 questionnaires with reminder letters were sent out to residents who had not yet responded. A total response rate of 46% was achieved. Response rates from each suburb ranged from 33% (Linwood) to 61% (Bishopdale).

The questionnaire responses were coded and entered into a computerized database.[38] The analysis of responses included the calculation of means and percentage of responses to each question to allow for an overview of the response patterns in each area.

Case Study and Control Areas

The suburbs of Beckenham, Papanui, Upper Riccarton, Bishopdale, and St Albans were selected for the case study because there is at least one CPBS within each of these communities. Census data, providing demographic and socioeconomic characteristics of geographic areas, was used to select the control suburbs of Spreydon, Linwood, Bromley, Avonhead, and Ilam.[39] The control areas are located further away (over 1 kilometer) from the CPBS in their matched case study area. As well as matching demographic and socioeconomic characteristics, each suburb was selected based on its similarity to its matched case study area in terms of living environment and housing stock, distance to the central business district, and geographic size; the only dissimilarity is that there are no CPBSs in the control areas. (See Appendix I for a location map.)

Demographic statistics show that Bromley and Ilam comprise a younger population (median age about 33), with Bishopdale and Upper Riccarton having an older population (median age about 40). The ethnic breakdown of each suburb indicates that Papanui and Spreydon have the highest proportion of Europeans (about 90%), Bromley has the highest proportion of both Maoris and Pacific Islanders (13.9% and 8.5% respectively), while Ilam, Avonhead, and Upper Riccarton have the highest proportion of Asians (16.1% to 18.5%).[40]

Median household and median family incomes (MHI and MFI) are highest in Ilam and Avonhead (MHI: $34,751NZ, $53,405NZ; MFI: $51,530NZ, $65,804NZ, respectively) and lowest in Linwood and Beckenham (MHI: $22,275NZ, $26,398NZ; MFI: $29,673NZ, $33,847NZ respectively).[41] Residents of St Albans West have the highest levels of education (21.7% have a degree or a higher degree) followed by Upper Riccarton (18.7%), Ilam (16.7%), and Avonhead (16.2%). These same suburbs have the highest proportion of professionals by occupational class (20.3% to 27.3%). Residents of Bromley have the lowest education (40% have no qualification) and the lowest proportion of professionals (5.5%).[42]

In summary, the socioeconomic data shows that Ilam is the more superior suburb, followed by Avonhead, Upper Riccarton, St Albans West, and Papanui. The lower socioeconomic areas are, in decreasing order, Spreydon, Bishopdale, Bromley, Beckenham, and Linwood.

Survey Results

A summary of the main findings from the survey is presented in Appendix II, and the survey results are discussed in the following.

Response Rates

Of the 800 questionnaires mailed to homeowners and tenants in the case study and control areas (400 to each group), 50% from the case study area and 41%

37. Approved by the University of Auckland Human Subjects Ethics Committee (reference 2002/185).

38. The computer program SPSS was selected as the appropriate analytical tool for processing the data.

39. The census is conducted in New Zealand every five years, and the data used to define the control areas is from the latest census conducted in 2001, see Christchurch City Area Unit Profile, 2001 at http://www.ccc.govt.nz/Census/ChristchurchCityAreaUnitProfile.xls.

40. Christchurch City Area Unit Profile statistics.

41. $1NZ = $0.65US, thus, $34,751NZ = $22,588US.

42. The median house price for Christchurch city in August 2003 was $185,000NZ/$120,000US (New Zealand national median house price at this time was $215,000NZ/$140,000US), http://www.reinz.co.nz/files/HousingFacts-Sample-Pg1-5.pdf (accessed March 17, 2004). Median house prices in each individual suburb could not be obtained as the median sales data from the Real Estate Institute of NZ (REINZ) contains more than one suburb in each location grouping.

from the control area were completed and returned. Over three-quarters (78.5%) of the case study respondents were homeowners compared to 94% in the control area.

Desirability of the Suburb as a Place to Live

More than half (58.3%) the case study respondents have lived in their suburb for more than five years (compared to 65% in the control group) and a quarter (25%) have lived in their suburb between 1 and 4 years (compared to 28% in the control group).

Around two-thirds (65% of the case study respondents and 68% of the control group respondents) rated their neighborhoods as either above average or superior as a place to live when compared with other similar named suburbs. The reasons given for this include close proximity to amenities (shops, library, medical facilities, public transport, and recreational facilities) and good schools.

Reasons given for rating the case study neighborhoods inferior to other similar neighborhoods include lower house prices, older homes, more student housing and lower-income residents. The reasons given by the control group respondents for an inferior rating include distance from the central business district (Avonhead); smell from the sewerage oxidation ponds and composting ponds (Bromley); and lower socioeconomic area and noise from the airport (Linwood).

Feelings About a CPBS as an Element of the Neighborhood

In the case study areas, a CPBS had already been constructed when only 39% of the respondents bought their houses or began renting in the neighborhood. Some responded that they were not notified that the CPBS was to be built, that they had no opportunity to object to it, and that they felt they should have been consulted about its construction. For the respondents who said that proximity to the tower was of concern to them, the most common reasons given for this were the impact of the CPBS on health, aesthetics, and property values. Nearly three-quarters (74%) of the respondents said they would have gone ahead with the purchase or rental of their property anyway if they had known that the CPBS was to be constructed.

In the control areas nearly three-quarters (72%) of the respondents indicated they would be opposed to construction of a CPBS nearby. The location of a CPBS would be taken into account by 83% of respondents if they were to consider moving. As with the case study respondents, the control group respondents who were concerned about proximity to a CPBS were most often concerned about the effects of CPBSs on health, aesthetics, and property values.

Impact on Decision to Purchase or Rent

In the case study areas, the tower was visible from the houses of 46% of the respondents, yet two-thirds (66%) of these said it was barely noticeable, and one-quarter said it mildly obstructed their view. When asked in what way the CPBS impacts the enjoyment of living in their home, 37% responded that its impact was related to health concerns, 21% said it impacted neighborhood aesthetics, 20% said it impacted property value, and 12% said it impacted the view from their property.

When asked about the impact that the CPBS had on the price/rent they were prepared to pay for their property, over half the case study respondents (53.1%) said that the tower was not constructed at the time of purchase/rental, and 51.4% of the respondents said the proximity to the CPBS did not affect the price they were prepared to pay for the property. Nearly 3% said they were prepared to pay a little less, 2% said they were prepared to pay a little more. For the control group respondents, 45% of the respondents would pay substantially less for a property if a CPBS were located nearby, over one-third (38%) were prepared to pay just a little less for such a property, and 17% responded that a CPBS would not influence the price they would pay.

Only 10% of the case study respondents gave an indication of the impact that the CPBS had on the price/rent they were prepared to pay for the property; one-third of these felt it would decrease price/rent by 1% to 9%. For the control group, over one-third (38%) of the respondents felt that a CPBS would decrease price/rent by more than 20%, and a similar number (36%) said they would be prepared to pay 10% to 19% less for property located near a CPBS. The responses are outlined in Table 1.

Table 1 Impact of a CPBS on Purchase/Rental Price Decision

Price/Rent Effect	Percent of Case Study Respondents (Control Group Responses)
20% more	5% (3%)
10–19% more	10% (2%)
1–9% more	14% (2%)
1–9% less	33% (19%)
10–19% less	24% (36%)
20% or greater reduction in price/rent	14% (38%)

Interestingly, it would seem that those living farther away from the CPBSs (the control group) are far more concerned about proximity to CPBSs than those living near CPBSs (the case study group); they indicated that a CPBS would have a greater price/rent effect. The possible explanations for this are discussed in the survey results section.

Concerns About Proximity to the CPBS

Most case study respondents were not worried about the effects of proximity to a CPBS related to health (50%), stigma (55%), future property value (61%), or aesthetics (63%). About one-quarter to one-third of these respondents were somewhat worried about the impact of proximity to a CPBS on health (38%), stigma (34%), future property value (25%), or aesthetics (25%). From the list of issues, respondents were most worried about future property value, but only 13.5% of the respondents responded this way.

Here again, control group respondents were much more concerned about the effects of proximity to a CPBS than their case study counterparts. Of the possible concerns about CPBSs on which respondents were asked to comment, control group respondents were most worried about the negative effects on future property values and aesthetics. Nearly half the respondents were worried a lot about these issues. Similar responses were recorded for the possibility of harmful health effects in the future from CPBSs (42% were worried a lot about this) and stigma associated with houses near CPBSs (34% were worried a lot). The responses regarding concerns about living near a CPBS are shown in Table 2.

In both the case study and control areas, the issue of greatest concern for respondents was the impact of proximity to CPBSs on future property values. The main concerns related to CPBSs were the unknown potential health effects, the possible socioeconomic implications of the siting of CPBSs, and how CPBSs affect property values. There also were concerns that the city council was not notifying the public about the possible construction of CPBSs.

Discussion of the Survey Results

The results were mixed, with responses from residents ranging from having no concerns to being very concerned about proximity to a CPBS. In general, those people living in areas farther from CPBSs were much more concerned about issues related to proximity to CPBSs than residents who lived near CPBSs.

Over 40% of the control group respondents were worried a lot about future health risks, aesthetics, and future property values compared with the case study areas, where only 13% of the respondents were worried a lot about these issues. However, in both the case study and control areas, the impact of proximity to CPBSs on future property values is the issue of greatest concern for respondents. If purchasing or renting a property near a CPBS, over a third (38%) of the control group respondents said a CPBS would reduce the price of their property by more than 20%. The perceptions of the case study respondents were again less negative, with a third saying they would reduce the price by only 1%–9%, and 24% saying they would reduce the price by 10%–19%.

The lack of concern shown by the case study respondents may be due to the CPBSs being either not visible or only barely visible from their homes. The CPBSs may be far enough away from respondents' properties (as was indicated by many respondents, particularly in St Albans West, Upper Riccarton, and Bishopdale) or hidden by trees and consequently not perceived as affecting the properties. The results may have been quite different had the CPBS being more visually prominent.

Alternatively, the apparent lower sensitivity to CPBSs of case study residents compared to the control group residents may be due to cognitive dissonance reduction. In this case, respondents may be unwilling to admit, due to the large amounts of money already paid, that they may have made a poor purchase or rental decision in buying or renting property located near a CPBS. Similarly, the homeowners may be unwilling to admit there are concerns about CPBSs when the CPBSs were built

Table 2 Concerns about Living Near a CPBS*

Concern	Does not worry me	Worries me somewhat	Worries me a lot
Possibility of harmful health effects	50% (20%)	38% (38%)	12% (42%)
Stigma effect	55% (21%)	34% (45%)	12% (34%)
Effect on future property values	61% (15%)	25% (37%)	13% (47%)
Aesthetics	63% (18%)	25% (37%)	11% (45%)

* Percent of case study respondents having that concern (control group respondents). All numbers are rounded.

after they had purchased their homes, because to do so might have a negative impact on property values.

Regardless of the reasons for the difference in responses from the case study and control groups, the overall results show that residents perceive CPBSs negatively. In both the case study and control areas, the impact of proximity to CPBSs on future property values was the issue of greatest concern for respondents. Overall, respondents felt that proximity to a CPBS would reduce value by from 10% to over 20%. The second part of the study outlined below, involving an econometric analysis of Christchurch property sales transaction data, helps to confirm these results.

Respondents' comments added at the end of the survey indicate that residents have ongoing concerns about CPBSs. Although some people accepted the need for CPBSs, they said that they did not want them built in their back yard, or they preferred that they be disguised to blend better with their environment.

Market Study Research Objectives and Methodology

A market study was undertaken to test the hypothesis that in suburbs where there is a CPBS it will be possible to observe discounts to the selling price of homes located near these structures. Such discounts would be observed where buyers of proximate homes view the CPBSs in negative terms due to a perceived risk of adverse effects on health, aesthetics, and property value.

The literature dealing specifically with the measurement of the impact of environmental hazards on residential sale prices (including proximity to transmission lines, landfill sites, and ground water contamination) indicates the popularity of hedonic pricing models, as introduced by Court[43] and later Griliches,[44] and further developed by Freeman[45] and Rosen.[46] The more recent studies, including those by Dotzour;[47] Simons and Sementelli;[48] and Reichert,[49] focus on proximity to an environmental hazard and demonstrate that this reduces residential house prices by varying amounts depending on the distance from the hazard.[50] However, there are no known published studies that use hedonic housing models to measure the impact of proximity to a CPBS on residential property values.

As in the previous residential house price studies, the standard hedonic methodology was used here to quantify the impact of a CPBS on sale prices of homes located near a CPBS. The results from this study in tandem with the opinion survey results will help test the hypothesis that proximity to a CPBS has a negative impact on property value and will reveal the extent to which the market reacts to CPBSs.

Model Specification

A hedonic price model is constructed by treating the price of a property as a function of its utility-bearing attributes. Independent variables used in the model to account for the property attributes are limited to those available in the data set and known, based on other well-tested models reported in the literature and from valuation theory, to be related to property price. The basic model used to analyze the impact on sale price of a house located near a CPBS, is as follows:

$$P_i = f(X_{1,i}, X_{2,i} \ldots \ldots \ldots \ldots \ldots X_{n,i})$$

where:

P_i = property price at the i th location

$X_{1,i} \ldots X_{n,i}$ = individual characteristics of each sold property (e.g., land area, age of house, floor area, sale date, construction materials, house condition, CPBS construction date, etc.)

The more recent hedonic pricing studies that demonstrate the effects of proximity to an environmental hazard use different functional forms to represent the relationship between price and various property characteristics.[51] In hedonic housing models the linear and log-linear models are most popular. The linear model implies constant partial effects between house prices and housing characteristics, while the log-linear model allows for nonlinear price effects and is shown in the following equation:

43. A. T. Court, "Hedonic Price Indexes with Automotive Examples," in *The Dynamics of Automobile Demand* (New York: General Motors, 1939).

44. Zvi Griliches, ed. *Price Indexes and Quality Change* (Cambridge, Mass.: Harvard University Press, 1971).

45. Freeman.

46. Rosen.

47. Mark Dotzour, "Groundwater Contamination and Residential Property Values," *The Appraisal Journal* (July 1997): 279–285.

48. Robert A. Simons and Arthur Sementelli, "Liquidity Loss and Delayed Transactions with Leaking Underground Storage Tanks," *The Appraisal Journal* (July 1997): 255–260.

49. Alan K. Reichert, "Impact of a Toxic Waste Superfund Site on Property Values," *The Appraisal Journal* (October 1997): 381–392.

50. Only Dotzour found no significant impact of the discovery of contaminated groundwater on residential house prices. This was likely due to the nonhazardous nature of the contamination where the groundwater was not used for drinking purposes.

51. See for example L. Dale et al., "Do Property Values Rebound from Environmental Stigmas? Evidence from Dallas," *Land Economics* 75, no. 2 (May 1999): 311–326; Dotzour; Simons and Sementelli; and Reichert.

$$\ln P_i = b_0 + b_1 \times X_{1,i} + b_2 \times X_{2i} + b_3 \times X_{3i} \ldots \ldots \ldots + b_n \times X_{n+1} + a_o \times D_o + \ldots \ldots + a_m \times D_m + e_0$$

where:

$\ln P_i$ = the natural logarithm of sale price

b_0 = the intercept

$b_1 \ldots b_n$; $a_o \ldots a_m$ = the model parameters to be estimated, i.e., the implicit unit prices for increments in the property characteristics

$X_1 \ldots X_n$ = the continuous characteristics, such as land area

$D_o \ldots D_m$ = the categorical (dummy) variables, such as whether the sale occurred before (0) or after (1) the CPBS was built

Sometimes the natural logarithm of land area and floor area is also used. The parameters are estimated by regressing property sales on the property characteristics and are interpreted as the households' implicit valuations of different property attributes. The null hypothesis states that the effect of being located near a CPBS does not explain any variation in property sale prices.

The Data

Part of the process for selecting appropriate case study areas was identifying areas where there had been a sufficient number of property sales to provide statistically reliable and valid results. Sales were required for the period before and after the CPBS had been built in order to study the impact of the CPBS on the surrounding properties' sale prices.

Further, due to the multitude of factors that combine to determine a neighborhood's character, such as proximity to the central business district, standard of schooling, recreational facilities provided, standard of housing, proximity to amenities, and the difficulty in allowing for these separately, sales located in areas with comparable neighborhood characteristics were preferred.

Four of the suburbs in the survey case study met the criteria for the market study: St Albans, Beckenham, Papanui, and Bishopdale. No sales data was available for Upper Riccarton after the CPBS was built in this suburb, hence this suburb was not included in the market analysis study. As each CPBS was built at a different date, the sales from each suburb were separately analyzed. The uniformity of locational and neighborhood characteristics in each of these suburbs allows the analysis to be simplified and to focus on the properties' physical attributes. The relative homogeneity of housing, locational, and neighborhood attributes was verified through field inspections.

The dependent variable is the property sale price. The data set includes 4283 property sales that occurred between 1986 and 2002 (approximately 1000 sales per suburb).[52]

The independent data set was limited to those variables that correspond to property attributes known and suspected to influence price. These variables are floor area (m^2); land area (ha); age of the house (the year the house was built); tower (a dummy variable indicating whether the sale occurred before or after the CPBS was built); sale date (month and year); time of sale based on the number of quarters before or after the CPBS was built (to help control for movements in house prices over time); category of residential property (stand-alone dwelling, dwelling converted into flats, ownership unit, etc); quality of the principal structure (as assessed by an appraiser); and roof and wall materials. The number of bedrooms was not available in the data set, but would not have been included as an independent variable since the number of bedrooms is highly correlated with floor area.

Since the GIS coordinates of properties for the initial analysis were not available, street name was included as an independent variable instead. To a limited extent, street name helped to control for the proximity effects of a CPBS. It was suspected that houses on a street close to a CPBS may, on average, sell for less than houses on a street farther away from the CPBS.

While views, particularly water views, have been shown in previous empirical studies to be an important attribute affecting sale price, in the present study the flat contour of the landscape where the homes are located, together with the suburban nature of the environment surrounding these, precluded any significant views. Thus, views were not included in the analysis. Further, due to the large number of sales included in the analysis, inspections of each individual property were not made to determine the view, if any, of a CPBS from each house. It was felt that it is not merely the view that may impact on price, but also proximity to a CPBS due to the potential effect this may have on health, cell phone coverage, and neighborhood aes-

52. These sales were obtained from Headway Systems Ltd, a data distribution and system development company. Headway is the major supplier of property market sales information to New Zealand's valuation profession; it is jointly owned by the NZ Institute of Valuers (NZIV) and PT Investments, a consortium of 28 shareholders from within the property industry.

thetics. Hence, view of a CPBS was not included as an independent variable. The variable descriptions are listed in Table 3. Variable codes are shown in Appendix III and basic descriptive statistics for selected quantitative variables are shown in Appendix IV.

Table 3 Variable Descriptions

Variable*	Definition
SLNETX	Sale price of the house (NZ$)
SITSTX	Street name
CATGYX2	Category of dwelling: D, E, etc.†
CATGYX4	Quality of the structure: A, B, C†
TIMESOLD.Q	Using the time the cell phone tower was built as a baseline quarter, the number of quarters before (–) and after (+) it was built
AGE	Year the house was built
LANDAX	Land area (ha)
MATFAX	Total floor area (m^2)
WALLCNX	Wall construction: W, B, C, etc. †
ROOFCNX	Roof construction: W, B, C, etc. †
TOWER	An indicator variable: 0 if before the cell phone tower was built, or 1 after it was built

* Sale price is the dependent variable.

† See Appendix III for explanation of variable codes.

Market Study Results

An econometric analysis of Christchurch property transaction data helped to confirm the opinion survey results. In the analysis of selected suburbs, the sales data from sales that occurred before a CPBS was built was compared to sales data from after a CPBS was built to determine any variance in price, after accounting for all the relevant independent variables.

Empirical Results

The model of choice is one that best represents the relationships between the variables and has a small variance and unbiased parameters. Various models were tested and the results are described in the next section. The following statistics were used to help select the most appropriate model: the adjusted coefficient of determination (adjusted R^2); the standard error of the regression equation; the AIC[53] and BIC[54] statistics; and *t*-test of significance of the coefficients and *F*-statistic.

Significance of Variables and the Equation: St Albans

As hedonic prices can vary significantly across different functional forms, various commonly used functional forms were examined to determine the model specification that best describes the relationship between price and the independent variables. Also, to test the belief that the relationship between *Price* and *Land Area* is not a linear function of *Price,* the variable *LANDAX* (land area) was transformed to reflect the correct relationship. Several transformations were tested including: linear of *SLNETX* (sale price) and log of *LANDAX*; log of *SLNETX* and linear of *LANDAX;* and log of *SLNETX* and log of *LANDAX*. All dummy variables remained in their linear form in each model.

It was found that the best result was obtained from using the log of *SLNETX* and log of *LANDAX*, and the linear form of all the dummy variables. Taking the log of an independent variable implies diminishing marginal benefits. For example, an extra 50 square meters of land area on a 550-square-meter site would be worth less than the previous 50 square meters. The log-log model shows the percent change in price for a one-percent change in the independent variable, while all other independent variables are held constant (as explained in Hill, Griffiths, and Judge).[55]

In the semilogarithmic equation the interpretation of the dummy variable coefficients involves the use of the formula: $100(e^{b_n} - 1)$, where b_n is the dummy variable coefficient.[56] This formula derives the percentage effect on price of the presence of the factor represented by the dummy variable and is advocated over the alternative, and commonly misused, formula of 100. (b_n). The resulting model included all the available variables as follows:

$$\begin{aligned}\log(SLNETX) = \alpha &+ \beta_1 \times TOWER + \beta_2 \times SITSTX \\ &+ \beta_3 \times CATGYX2 + \beta_4 \times CATGYX4 \\ &+ \beta_5 \times TIMESOLD \times Q + \beta_6 \times AGE \\ &+ \beta_7 \times \log(LANDAX) \\ &+ \beta_8 \times MATFAX \\ &+ \beta_9 \times WALLCNX \\ &+ \beta_{10} \times ROOFCNX\end{aligned}$$

53. AIC is the Akaike Information Criterion, and is a "goodness of fit" measure involving the standard error of the regression adjusted by a penalty factor. The model selected is the one that minimizes this criterion (Microsoft SPSSPC Online Guide, 1997).

54. The BIC is the Bayesian Information Criterion. Like the AIC, BIC takes into account both how well the model fits the observed data, and the number of parameters used in the model. The model selected is the one that adequately describes the series and has the minimum SBC. The SBC is based on Bayesian (maximum-likelihood) considerations. (Microsoft SPSSPC Online Guide, 1997).

55. R. Carter Hill, William E. Griffiths, and George G. Judge, *Undergraduate Econometrics* (New York: John Wiley & Sons, 1997).

56. See Robert Halvorsen and Raymond Palmquist, "The Interpretation of Dummy Variables in Semi-Logarithmic Equations," *American Economic Review* 70, no. 3 (1980): 474–475.

From the regression output, the variables *ROOFCNX* and *WALLCNX* were found to be insignificant so these were removed from the model and the regression was rerun. The table in Appendix V summarizes these results. The *F*-statistic (123) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 4 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variables *ROOFCNX* and *WALLCNX* is superior to the regression that includes them (AIC and BIC are minimized). For this reason, the model excluding these variables was selected for analysis, and it is discussed next.

Table 4 Test Statistics — St Albans

	Adjusted R^2	AIC	BIC
Full Model	0.82	-118.38	36.55
Sub Model	0.82	-121.64	5.95

Tests for normality, heteroskedasticity, and multicollinearity generally indicated that the model was adequately specified and that the data were not severely ill conditioned (heteroskedasticity and multicollinearity were diminished when the data were transformed).

The coefficient of determination (R^2) indicates that approximately 82% of the variation in sale price is explained by the variation in the independent variable set. All variable coefficients had the expected signs,[57] except for *TOWER*, which was positive. The positive coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in St Albans, the price of a house would increase by $e^{0.1133} \approx 1.12$ (12%). A possible explanation is that cell phone technology was quite new at the time (1994), and as there had been little in the media about possible adverse health effects from CPBSs, people may have perceived it as a benefit as they were likely to get better cell phone coverage.

The most significant variables were *TIMESOLD.Q* (the quarter in which the sale occurred before or after the CPBS was built), *log(LANDAX)* (log of land area), and *MATFAX* (total floor area) and all have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built (1994), but only to a limited extent (1.38%). The positive log of land area and total floor area shows that prices increase with increasing size.

The regression coefficient on *log(LANDAX)* is 0.3285, which indicates that, on average, a 10% increase in *LANDAX* will generate a 3.285% increase in price. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, for each additional m^2 the price would increase by $e^{0.0022514} \approx 1.0022314$ (0.22% increase).

Significance of Variables and the Equation: Papanui

The same functional form used for St Albans was used for Papanui. From the regression output, the variable *CATGYX2* was found to be insignificant so it was removed from the model and the regression was rerun; Appendix VI summarizes the results. The *F*-statistic (152) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 5 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *CATGYX2* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding this variable was selected for analysis, and is discussed next.

Table 5 Test Statistics — Papanui

	Adjusted R^2	AIC	BIC
Full Model	0.87	-509.91	-371.99
Sub Model	0.87	-510.57	-381.56

The coefficient of determination (R^2) indicates that approximately 87% of the variation in sale price is explained by the variation in the independent variable set. This would be considered high in comparison with the amount of explanation obtained in similar hedonic house studies reported in the literature.[58] All variable coefficients had the expected signs.

The most significant variables were *TIMESOLD.Q, MATFAX* (total floor area), and *TOWER*. The former two have a positive influence on price. The positive *TIMESOLD.Q* indicates that the

57. Note that the variable *AGE* is positive as this variable indicates the year the house was built; therefore, the higher the year, the younger the home. Newer houses have less wear and tear than older homes and sell, on average, for more than older homes.

58. For example, Reichert obtained an adjusted R^2 of 84%; Simons and Sementelli, 78%; Abelson, 68%; Dotzour, 56%–61%.

market was increasing over time since the CPBS was built (2000), but only by 1.4% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by $e^{0.0042576} \approx 1.00427$ (0.43%), with increasing size. The negative coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in Papanui, the price of a house would decrease by $e^{-0.2340} \approx 0.79$ (21% decrease).

Significance of Variables and the Equation: Beckenham

The same functional form used for Papanui and St Albans was used for Beckenham. From the regression output, the variable *ROOFCNX* was found to be insignificant so it was removed from the model and the regression was rerun; Appendix VII summarizes these results. The *F*-statistic (214) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 6 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *ROOFCNX* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding this variable was selected for analysis.

Table 6 Test Statistics — Beckenham

	Adjusted R^2	AIC	BIC
Full Model	0.89	-819.00	-641.39
Sub Model	0.89	-818.66	-650.66

The coefficient of determination (R^2) indicates that approximately 89% of the variation in sale price is explained by the variation in the independent variable set. Again, as with the model for Papanui this amount of explanation would be considered high.

The most significant variables were *TIMESOLD.Q*, *MATFAX*, and *TOWER*. The former two have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built in 2000, but only by 1.91% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by $e^{0.0042054} \approx 1.00421$ (0.42%), with increasing size. The negative coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in Beckenham, the price of a house would decrease by $e^{-0.23019} \approx 0.793$ (20.7% decrease).

Significance of Variables and the Equation: Bishopdale

The same functional form used for the other three suburbs was used for Bishopdale. From the regression output, the variables *ROOFCNX* and *CATGYX* were found to be insignificant so these were removed from the model and the regression was rerun; Appendix VIII summarizes these results. The *F*-statistic (122) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 7 Test Statistics — Bishopdale

	Adjusted R^2	AIC	BIC
Full Model	0.79	-927.48	-775.71
Sub Model	0.79	-929.32	-796.52

Table 7 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *ROOFCNX* and *CATGYX* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding these variables was selected for analysis.

Again, the most significant variables were *TIMESOLD.Q* and *MATFAX*; the variable of interest, *TOWER*, was not a significant variable in the model so it is not discussed further. The former two variables have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built in 1994, but only at 0.98% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by $e^{0.0059665} \approx 1.004$ (0.40%), with increasing size.

Summary of Results

The above analysis shows that the most significant variables and their impact on price were similar between suburbs. This indicates the relative stability of the coefficients between each model. Interestingly, the impact of *TOWER* on price (a decrease of between 20.7% and 21%) was very similar in the two suburbs where the towers were built in the year 2000. This may be due to the much greater media publicity given to CPBSs after the two legal cases in Christchurch (*McIntryre* and *Shirley Primary School*

in 1996 and 1999, respectively). The two suburbs where *TOWER* was either insignificant or increased prices by around 12%, were suburbs where towers had been built in 1994, prior to the media publicity.

Limitations of the Research

The main limitation affecting this survey was in the selection of the case study areas. Specifically, the areas selected had CPBSs that were not highly visible to residents. If more-visible CPBSs had been selected, the results may have been quite different. Thus, caution must be used in making generalizations from this study or applying the results directly to other similar studies or valuation assignments. Factors that could affect results are the distance of homes from the CPBS, the style and appearance of the CPBS, how visible the CPBS is to residents, the type of home (single family, multifamily, rental, etc.), and the socioeconomic make-up of the resident population.

To help address the proximity factor, a study is in progress examining the role of distance to the CPBSs and price effects; that study uses GIS analysis to determine the impact this has on residential property prices. It is expected that this will provide a more precise estimation of the impact of a CPBS on price.

It must be kept in mind that these results are the product of only one case study carried out in a specific area (Christchurch) at a specific time (2003). The above results indicate that value effects from CPBSs may vary over time as market participants' perceptions change. Perceptions toward CPBSs can change either positively or negatively over time. For example, as the World Health Organization's ten-year study of the health effects from CPBSs is completed and becomes available, consumers' attitudes may become more positive or negative depending on the outcome of that study. Consequently, studies of the price effects of CPBSs need to be conducted over time.

Areas for Further Study

This research has focused on residents' perceptions of negative effects from proximity to CPBSs and how these impact property values, rather than the scientific or technological estimates of these risks. The technologists' objective view of risk is that risk is measurable solely in terms of probabilities and severity of consequences, whereas the public, while taking experts' assessments into account, view risk more subjectively, based on other factors. Further, the results of scientific studies about the health effects of radio frequency and microwave radiation from CPBSs are not consistent. Residents' perceptions and assessments of risk vary according to a wide range of psychological, social, institutional, and cultural processes, and this may explain why their assessments differ from those of the experts.

Given the public concerns about the potential risks arising from being located nearby a CPBS, it is important for future studies to focus more attention on the kinds of risks the public associates with CPBSs and the level of risk perceived. How far away from the CPBS do people feel they have to be to be safe? What CPBS design, size, and surrounding landscape would help CPBSs to be more publicly acceptable? What social, economic, educational, and other demographic variables influence how people perceive the risks from CPBSs? Do residents that are heavy users of cell phones have a different perception of CPBSs than residents who make little use of this technology? Are these perceived risks reflected in property values and to what extent? Do these perceived risks vary over time and to what degree?

Answers to these questions, if shared among researchers and made public, could lead to the development of a global database to assist appraisers in determining the perceived level of risk associated with CPBSs and other similar structures.[59] Knowledge of the extent that these risks are incorporated into property prices and how they vary over time will lead to more accurate value assessments of properties in close proximity to CPBSs and other similar structures.

Summary and Conclusions

Focusing on four case study neighborhoods in Christchurch, New Zealand, this article presents the results from both an opinion survey and market sales analysis undertaken in 2003 to determine residents' perceptions towards living near a CPBS and how this may impact property prices. From the results, it appears that people who live close to CPBSs perceive the sites less negatively than those who live farther away.

The issue of greatest concern for survey respondents in both the case study and control areas is the impact of proximity to CPBSs on future property values. Overall, respondents would pay from 10%–19% less to over 20% less for a property if it were in close proximity to a CPBS.

The opinion survey results were generally confirmed by the market sales analysis using a hedonic house price approach. The results of the sales analysis show prices of properties were reduced by around 21% after a CPBS was built in the neighborhood. How-

59. For example, high-voltage overhead transmission lines.

ever, this result varies between neighborhoods, with a positive impact on price being recorded in one neighborhood, possibly due to the CPBS being built in that suburb before any adverse media publicity about CPBSs appeared in the local Christchurch press.

Research to date reports no clearly established health effects from radio frequency emissions of CPBSs operated at or below the current safety standards, yet recent media reports indicate that people still perceive that CPBSs have harmful effects. Thus, whether or not CPBSs are proven to be free from health risks is only relevant to the extent that buyers of properties near CPBSs perceive this to be true. Even buyers who believe that there are no adverse health effects from CPBSs, knowing that other potential buyers might think the reverse, will probably seek a price discount for a property located near a CPBS.

The comments of survey participants indicate the ongoing concerns that residents have about CPBSs. There is the need to increase the public's understanding of how radio frequency transmitting facilities operate and the strict exposure-limit standards imposed on the telecommunication industry. As more information is discovered that refutes concerns regarding adverse health effects from CPBSs, and as information about the NZ safety standards are made more publicly available, the perception of risk may gradually change, eliminating the discounts for neighboring properties.

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Additional Reading

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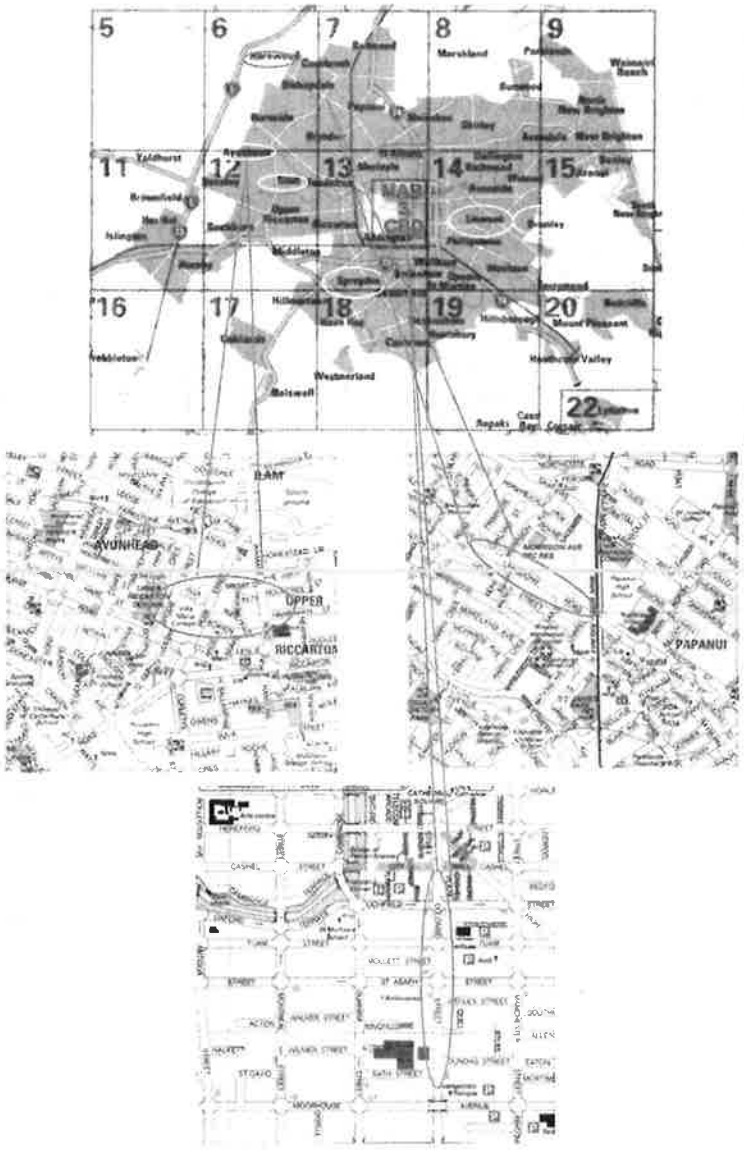
Appendix I Location Map



Areas circled in white at the top are without a cell phone tower, while areas circled in the bottom three maps have a cell phone tower.
Source: http://www.ccc.govt.nz/maps/Wises/

Appendix II Summary of the Survey Results

Variable	Responose	Valid Percent (%)	
		Case Study	Control
Occupancy	Homeowner	78.5	94.2
	Tenant	21.5	5.8
How long have you lived there?	Less than 6 months	8.0	2.6
	6 months–1 year	8.6	4.5
	1–4 years	25.1	27.7
	More than 5 years	58.3	65.2
How would you rate the desirability of your neighborhood?	Superior	27.4	30.9
	Above Average	37.4	36.8
	Average	28.5	27.0
	Below Average	5.6	4.6
	Inferior	1.1	0.7
Would you be opposed to construction of a cell phone tower nearby?	Yes		72.1
	No		27.9
When you purchased/began renting was the cell phone tower already constructed?	Yes	39.3	
	No	60.7	
Was the proximity of the cell phone tower a concern to you?	Yes	20.0	
	No	80.0	
Would you have gone ahead with rental/purchase if you had known a cell phone site was to be constructed?	Yes	73.9	
	No	26.1	
Is location of a cell phone tower a factor you would consider when moving?	Yes		83.4
	No		16.6
Is the cell phone tower visible from your house?	Yes	45.7	
	No	54.3	
If yes, how much does it impact on your view?	Very obstructive	9.6	
	Mildly obstructive	24.5	
	Barely noticeable	66.0	
In what way does it impact on the enjoyment of living in your house?	Views	11.8	
	Aesthetics	20.6	
	Health concerns	36.8	
	Change in property value	19.9	
	Other	11.0	
Effect a nearby cell phone tower would have on the price/rent you would pay for the property	Tower wasn't constructed	53.1	
	Pay substantially more	0.0	0.0
	Pay a little more	2.3	0.0
	Pay a little less	2.8	37.6
	Pay substantially less	0.6	45.4
	Not influence price	51.4	17.0
% Effect a nearby cell phone tower would have on the price/rent you would pay for the property	20% higher or more	5	3.2
	10–19% more	10	1.6
	1–9% more	14	2.4
	1–9% less	33	19.2
	10–19% less	24	36.0
	20% or a greater reduction	14	37.6
Concern about the possibility of harmful health effects in the future	Does not worry me	50.3	19.9
	Worries me somewhat	38.0	38.4
	Worries me a lot	11.7	41.7
Concern about the stigma associated with houses near the cell phone sites	Does not worry me	54.6	20.8
	Worries me somewhat	33.9	45.0
	Worries me a lot	11.5	34.2
Concern about the affect on your properties value in the future	Does not worry me	61.3	15.4
	Worries me somewhat	25.4	37.2
	Worries me a lot	13.3	47.4
Concern about the aesthetic problems caused by the tower	Does not worry me	63.3	18.2
	Worries me somewhat	25.4	37.0
	Worries me a lot	11.3	44.8

Appendix III Variable Codes

Category of Dwelling

Code	Definition
D	Dwelling houses are of a fully detached or semi-detached style situated on their own clearly defined piece of land.
E	Converted dwelling houses that are now used as rental flat.
F	Ownership home units which may be single storey or multi-storey and which do not have the appearance of dwelling houses.
H	Home and income. The dwelling is the predominant use, and there is an additional unit of use attached to or associated with the dwelling house that can be used to produce income.
R	Rental flats that have been purpose built.

Quality of the Principal Structure

Code	Definition
A	Superior design and quality of fixtures and fittings is first class.
B	The design is typical of its era and the quality of the fixtures and fittings is average to good.
C	The design is below the level generally expected for the era, or the level of fixtures and fittings is barely adequate and possibly of below average quality.

Building Materials: Walls and Roof

Code	Definition
W	Wood
B	Brick
C	Concrete
S	Stone
R	Roughcast
F	Fibrolite
M	Malthoid
P	Plastic
I	Iron
A	Aluminium
G	Glass
T	Tiles
X	*

Appendix IV Descriptive Statistics

Variable	Mean	Std. dev.	Median	Minimum	Maximum	Range
St Albans:						
Sale Price ($)	221,957	110,761	200,000	42,000	839,000	797,000
Land Area (ha)	0.0658	0.0331	0.0579	0.0261*	0.3794	0.3533
Floor Area (m^2)	161	70.40	150	50	450	400
Beckenham:						
Sale Price ($)	116,012	50,037	111,000	21,500	385,000	363,500
Land Area (ha)	0.0601	0.0234	0.0553	0.0164*	0.2140	0.1976
Floor Area (m^2)	115	32.50	110	40	340	300
Papanui:						
Sale Price ($)	127,661	51,114	119,000	43,000	375,000	332,000
Land Area (ha)	0.0685	0.0289	0.0675	0.0310	0.3169	0.2859
Floor Area (m^2)	122	34.60	110	56	290	234
Bishopdale:						
Sale Price ($)	136,786	41,390	134,500	56,000	342,000	286,000
Land Area (ha)	0.0679	0.0163	0.0653	0.0400	0.2028	0.1628
Floor Area (m^2)	125	31.20	118	64	290	226

* These small land areas are related to apartments or units in a block of apartments/units that have the land area apportioned on a pro rata basis.

Appendix V Regression Model: St Albans

log(*SLNETX*) = *TOWER* + *CATGYX2* + *CATGYX4* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *SITSTX*

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.72855	-0.15032	0.01593	0.14263	0.72047

Coefficients:	**Estimate**	**Std. Error**	***t*-value**	**Pr(>|t|)**
(Intercept)	9.1781868	0.6769096	13.559	< 2e-16 ***
TOWER	**0.1133186**	0.0318188	**3.561**	0.000395 ***
CATGYX2D	0.1846417	0.0702520	2.628	0.008776 **
CATGYX2O	0.0334663	0.1008594	0.332	0.740134
CATGYX4B	-0.1551409	0.0245485	-6.320	4.75e-10 ***
CATGYX4C	-0.1483169	0.0722959	-2.052	0.040600 *
TIMESOLD.Q	**0.0136663**	**0.0008208**	**16.650**	< 2e-16 ***
AGE	0.0016408	0.0003521	4.660	3.81e-06 ***
log(LANDAX)	**0.3285367**	**0.0283610**	**11.584**	< 2e-16 ***
MATFAX	**0.0022314**	**0.0001962**	**11.373**	< 2e-16 ***
SITSTXAIKMANS RD	0.4029259	0.0533671	7.550	1.41e-13 ***
SITSTXBEVERLEY ST	0.2330787	0.0803137	2.902	0.003827 **
SITSTXBRISTOL ST	0.1706840	0.0521716	3.272	0.001124 **
SITSTXBROWNS RD	0.2492536	0.0720854	3.458	0.000579 ***
SITSTXCOX ST	0.3055798	0.0581672	5.253	2.00e-07 ***
SITSTXGORDON AVE	0.0823422	0.0679833	1.211	0.226236
SITSTXKNOWLES ST	0.1690979	0.0558911	3.025	0.002576 **
SITSTXMANSFIELD AVE	0.2954242	0.0652983	4.524	7.16e-06 ***
SITSTXMCDOUGALL AVE	0.3303105	0.0623720	5.296	1.60e-07 ***
SITSTXMURRAY PL	0.3613773	0.0629166	5.744	1.40e-08 ***
SITSTXOFFICE RD	0.3681146	0.0543368	6.775	2.71e-11 ***
SITSTX Other	0.0618491	0.0736629	0.840	0.401416
SITSTXPAPANUI RD	0.1940369	0.0560474	3.462	0.000570 ***
SITSTXRANFURLY ST	0.1701716	0.0617504	2.756	0.006012 **
SITSTXST ALBANS ST	0.1458665	0.0571172	2.554	0.010873 *
SITSTXWEBB ST	0.1895432	0.0725061	2.614	0.009143 **
SITSTXWESTON RD	0.2084419	0.0527555	3.951	8.60e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2175 on 677 degrees of freedom
Multiple *R*-Squared: 0.8253, Adjusted *R*-squared: 0.8186
F-statistic: 123 on 26 and 677 DF, *p*-value: < 2.2e-16

Appendix VI Regression Model: Papanui

ln(formula = log(*SLNETX*) ~ *TOWER* + *SITSTX* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *WALLCNX* + *ROOFCNX* + *CATGYX4*, data = *Papanui.final*)

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.484987	-0.098006	0.003859	0.106253	0.563126

Coefficients:	**Estimate**	**Std. Error**	***t*-value**	**Pr(>|t|)**
(Intercept)	5.9482316	0.6998186	8.500	< 2e-16 ***
TOWER	**-0.2339640**	0.0240908	**-9.712**	< 2e-16 ***
SITSTXHOANI ST	-0.1966982	0.0265429	-7.411	4.26e-13 ***
SITSTXLANGDONS RD	-0.1192547	0.0281242	-4.240	2.58e-05 ***
SITSTXLEANDER ST	0.0305555	0.0449437	0.680	0.496853
SITSTXMATSONS AVE	0.0949636	0.0292461	3.247	0.001231 **
SITSTXMORELAND AVE	-0.0892332	0.0397622	-2.244	0.025183 *
SITSTXMORRISON AVE	-0.1984492	0.0289772	-6.848	1.84e-11 ***
SITSTXOther	-0.1543194	0.0337436	-4.573	5.83e-06 ***
SITSTXSAILS ST	-0.0761412	0.0433455	-1.757	0.079490 .
SITSTXSAWTELL PL	0.1840793	0.0393904	4.673	3.66e-06 ***
SITSTXSAWYERS ARMS RD	0.0872393	0.0201388	4.332	1.73e-05 ***
SITSTXST JAMES AVE	0.2497688	0.0289940	8.615	< 2e-16 ***
TIMESOLD.Q	**0.0138914**	0.0004137	**33.575**	< 2e-16 ***
AGE	0.0029307	0.0003512	8.345	4.85e-16 ***
log(LANDAX)	0.0904764	0.0270812	3.341	0.000886 ***
MATFAX	**0.0042576**	0.0002410	**17.664**	< 2e-16 ***
WALLCNXC	0.0054100	0.0200666	0.270	0.787558
WALLCNXF	-0.0980851	0.0464442	-2.112	0.035106 *
WALLCNXO	-0.1158407	0.0468334	-2.473	0.013655 *
WALLCNXR	-0.0670051	0.0244382	-2.742	0.006291 **
WALLCNXW	-0.0679166	0.0192628	-3.526	0.000454 ***
WALLCNXX	-0.0571365	0.0358369	-1.594	0.111381
ROOFCNXI	0.1502973	0.1139845	1.319	0.187810
ROOFCNXO	0.0870092	0.1164152	0.747	0.455111
ROOFCNXT	0.0954874	0.1138506	0.839	0.401965
CATGYX4B	-0.0623758	0.0343487	-1.816	0.069872 .
CATGYX4C	-0.3669901	0.0905659	-4.052	5.74e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.1579 on 604 degrees of freedom
Multiple *R*-Squared: 0.8718, Adjusted *R*-squared: 0.8661
F-statistic: 152.2 on 27 and 604 DF, *p*-value: < 2.2e-16

Appendix VII Regression Model: Beckenham

ln(formula = log(*SLNETX*) ~ TOWER + *SITSTX* + *CATGYX4* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *WALLCNX* + *CATGYX2*, data = *Beckenham.final*)

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.64490	-0.09026	0.01142	0.10112	0.40993

Coefficients:	**Estimate**	**Std. Error**	***t*-value**	**Pr(>|t|)**
(Intercept)	9.2062865	0.4725194	19.483	< 2e-16 ***
TOWER1	**-0.2301918**	0.0182774	**-12.594**	< 2e-16 ***
SITSTXBECKENHAM ST	0.1648069	0.0515406	3.198	0.001436 **
SITSTXBOON ST	-0.0616738	0.0484966	-1.272	0.203817
SITSTXBRADFORD AVE	0.0923843	0.0494942	1.867	0.062300 .
SITSTXCOLOMBO ST	0.0623765	0.0467234	1.335	0.182223
SITSTXDEVON ST	-0.0959430	0.0457562	-2.097	0.036299 *
SITSTXDUNN ST	-0.0207886	0.0427676	-0.486	0.627031
SITSTXFISHER AVE	0.2271245	0.0400288	5.674	1.90e-08 ***
SITSTXLONGFELLOW ST	-0.0186953	0.0451597	-0.414	0.678990
SITSTXOTHER	-0.0222126	0.0467607	-0.475	0.634888
SITSTXPERCIVAL ST	-0.0347190	0.0517740	-0.671	0.502663
SITSTXROXBURGH ST	0.1029109	0.0466753	2.205	0.027729 *
SITSTXSOMERFIELD ST	0.0186495	0.0428968	0.435	0.663851
SITSTXSOUTHAMPTON ST	-0.0243265	0.0402926	-0.604	0.546171
SITSTXSOUTHEY ST	-0.0324513	0.0429880	-0.755	0.450520
SITSTXSTRICKLAND ST	-0.0819418	0.0407196	-2.012	0.044494 *
SITSTXTENNYSON ST	0.1165007	0.0393410	2.961	0.003147 **
SITSTXWEMBLEY ST	0.0648226	0.0458033	1.415	0.157359
CATGYX4B	0.0275481	0.0373405	0.738	0.460864
CATGYX4C	-0.1168640	0.0469787	-2.488	0.013049 *
TIMESOLD.Q	**0.0189904**	0.0003396	**55.928**	< 2e-16 ***
AGE	0.0010988	0.0002426	4.530	6.74e-06 ***
log(LANDAX)	0.1546535	0.0195655	7.904	8.19e-15 ***
MATFAX	**0.0042054**	0.0002138	**19.674**	< 2e-16 ***
WALLCNXC	-0.0208433	0.0378338	-0.551	0.581833
WALLCNXF	-0.1171637	0.0394091	-2.973	0.003031 **
WALLCNXO	-0.0445073	0.0399745	-1.113	0.265849
WALLCNXR	-0.1119164	0.0235736	-4.748	2.41e-06 ***
WALLCNXW	-0.0629968	0.0222366	-2.833	0.004718 **
WALLCNXX	-0.0992564	0.0398493	-2.491	0.012933 *
CATGYX2D	0.1445276	0.0399650	3.616	0.000316 ***
CATGYX2F	0.3069113	0.0744524	4.122	4.11e-05 ***
CATGYX2R	0.2927391	0.1222453	2.395	0.016847 *

Signif. codes:0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.1515 on 864 degrees of freedom
Multiple *R*-Squared: 0.8911, Adjusted *R*-squared: 0.8869
F-statistic: 214.2 on 33 and 864 DF, *p*-value: < 2.2e-16

Appendix VIII Regression Model: Bishopdale

ln(formula = log(*SLNETX*) ~ *TOWER* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *WALLCNX* + *SITSTX*, data = *Bishopdale.final*)

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.55633	-0.08893	0.01446	0.08850	0.49048

Coefficients:	**Estimate**	**Std. Error**	***t*-value**	**Pr(>|t|)**
(Intercept)	9.0005033	0.6988891	12.878	< 2e-16 ***
TOWER	0.0262575	0.0182796	1.436	0.151259
TIMESOLD.Q	**0.0097887**	0.0004834	**20.251**	< 2e-16 ***
AGE	0.0013236	0.0003598	3.679	0.000249 ***
log(LANDAX)	0.1357753	0.0333622	4.070	5.16e-05 ***
MATFAX	**0.0039665**	0.0001855	**21.389**	< 2e-16 ***
WALLCNXC	-0.0169935	0.0108641	-1.564	0.118160
WALLCNXO	0.0785660	0.0336688	2.333	0.019863 *
WALLCNXR	-0.0693225	0.0300511	-2.307	0.021313 *
WALLCNXW	-0.0815023	0.0230110	-3.542	0.000420 ***
SITSTXCARDOME ST	0.0610536	0.0314227	1.943	0.052360 .
SITSTXCHEDWORTH AVE	0.0330487	0.0317738	1.040	0.298589
SITSTXCLOTILDA PL	**0.2252988**	0.0420078	**5.363**	1.06e-07 ***
SITSTXCOLESBURY ST	0.0528749	0.0302668	1.747	0.081018 .
SITSTXCOTSWOLD AVE	0.0604953	0.0286474	2.112	0.035012 *
SITSTXEASTLING ST	0.0551537	0.0319833	1.724	0.085003 .
SITSTXFARRINGTON AVE	-0.0001768	0.0238544	-0.007	0.994087
SITSTXHAREWOOD RD	0.0204412	0.0252674	0.809	0.418753
SITSTXHIGHSTED RD	0.0391760	0.0253953	1.543	0.123302
SITSTXKILBURN ST	-0.0176756	0.0366951	-0.482	0.630155
SITSTXKINGROVE ST	-0.0052772	0.0375965	-0.140	0.888406
SITSTXLEACROFT ST	0.1058243	0.0333633	3.172	0.001571 **
SITSTXMURMONT ST	0.1825316	0.0365287	4.997	7.12e-07 ***
SITSTXNEWMARK ST	-0.0342136	0.0272490	-1.256	0.209621
SITSTXOTHER	0.0525437	0.0253634	2.072	0.038612 *
SITSTXRALEIGH ST	0.0470151	0.0314032	1.497	0.134740
SITSTXSTACKHOUSE AVE	0.0235719	0.0278844	-0.845	0.398165

Signif. codes:0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.137 on 821 degrees of freedom
Multiple *R*-Squared: 0.7946, Adjusted *R*-squared: 0.7881
F-statistic: 122.1 on 26 and 821 DF, *p*-value: < 2.2e-16

Real Estate Survey: Do Cell/Grid Towers Impact a Property's Desirability?

July 04, 2014
by Take Back Your Power
by ElectromagneticHealth.org | see original news release

94% of respondents said a nearby cell tower or group of antennas would negatively impact value or interest in a property

The National Institute for Science, Law and Public Policy's survey **"Neighborhood Cell Towers & Antennas—Do They Impact a Property's Desirability?"** initiated June 2, 2014, has now been completed by 1,000 respondents as of June 28, 2014. The survey, which circulated online through email and social networking sites, in both the U.S. and abroad, sought to determine if nearby cell towers and antennas, or wireless antennas placed on top of or on the side of a building, would impact a home buyer's or renter's interest in a real estate property.

The overwhelming majority of respondents (94%) reported that cell towers and antennas in a neighborhood or on a building would impact interest in a property and the price they would be willing to pay for it. And 79% said under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antenna.

- **94% said a nearby cell tower or group of antennas would negatively impact interest in a property or the price they would be willing to pay for it.**
- **94% said a cell tower or group of antennas on top of, or attached to, an apartment building would negatively impact interest in the apartment building or the price they would be willing to pay for it.**
- **95% said they would opt to buy or rent a property that had zero antennas on the building over a comparable property that had several antennas on the building.**
- **79% said under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antennas.**
- **88% said that under no circumstances would they ever purchase or rent a property with a cell tower or group of antennas on top of, or attached to, the apartment building.**
- **89% said they were generally concerned about the increasing number of cell towers and antennas in their residential neighborhood.**

The National Institute for Science, Law and Public Policy (NISLAPP) was curious if respondents had previous experience with physical or cognitive effects of wireless radiation, or if their concern about neighborhood antennas was unrelated to personal experience with the radiation.

Of the 1,000 respondents, **57% had previously experienced cognitive effects from radiation emitted by a cell phone, wireless router, portable phone, utility smart meter, or neighborhood antenna or cell tower, and 43% had not experienced cognitive effects. 63% of respondents had previously experienced physical effects from these devices or neighborhood towers and antennas and 37% had not experienced physical effects.**

The majority of respondents provided contact information indicating they would like to receive the results of this survey or news related to the possible connection between neighborhood cell towers and antennas and real estate decisions.

Comments from real estate brokers who completed the NISLAPP survey:

"I am a real estate broker in NYC. I sold a townhouse that had a cell tower attached. Many potential buyers chose to avoid purchasing the property because of it. There was a long lease."

"I own several properties in Santa Fe, NM and believe me, I have taken care not to buy near cell towers. Most of these are rental properties and I think I would have a harder time renting those units... were a cell tower or antenna nearby. Though I have not noticed any negative health effects myself, I know many people are affected. And in addition, these antennas and towers are often extremely ugly–despite the attempt in our town of hiding them as chimneys or fake trees."

"We are home owners and real estate investors in Marin County and have been for the last 25 years. We own homes and apartment building here in Marin. We would not think of investing in real estate that would harm our tenants. All our properties are free of smart meters. Thank you for all of your work."

"I'm a realtor. I've never had a single complaint about cell phone antennae. Electric poles, on the other hand, are a huge problem for buyers."

Study: 21% reduction in property value if cell phone tower built

Concern was expressed in the comments section by respondents about potential property valuation declines near antennas and cell towers. While the NISLAPP survey did not evaluate property price declines, a study on this subject by Sandy Bond, PhD of the New Zealand Property Institute, and Past President of the Pacific Rim Real Estate Society (PRRES), The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods, was published in *The Appraisal Journal* of the Appraisal Institute in 2006. The Appraisal Institute is the largest global professional organization for appraisers with 91 chapters.

The study indicated that **homebuyers would pay from 10%–19% less to over 20% less for a property if it were in close proximity to a cell phone base station.** The 'opinion' survey results were then confirmed by a market sales analysis. **The results of the sales analysis showed prices of properties were reduced by around 21% after a cell phone base station was built in the neighborhood."**

Additional comments

The Appraisal Journal study added,

"Even buyers who believe that there are no adverse health effects from cell phone base stations, knowing that other potential buyers might think the reverse, will probably seek a price discount for a property located near a cell phone base station."

James S. Turner, Esq., Chairman of the National Institute for Science, Law & Public Policy and Partner, Swankin & Turner in Washington, D.C., says,

"The recent NISLAPP survey suggests there is now a high level of awareness about potential risks from cell towers and antennas. In addition, the survey indicates respondents believe they have personally experienced cognitive (57%) or physical (63%) effects from radiofrequency radiation from towers, antennas or other radiating devices, such as cell phones, routers, smart meters and other consumer electronics. Almost 90% are concerned about the increasing number of cell towers and antennas generally. A study of real estate sales prices would be beneficial at this time in the Unites States to determine what discounts homebuyers are currently placing on properties near cell towers and antennas."

Betsy Lehrfeld, Esq., an attorney and Executive Director of NISLAPP, says,

"The proliferation of this irradiating infrastructure throughout our country would never have occurred in the first place had Section 704 of the Telecommunications Act of 1996 not prohibited state and local governments from regulating the placement of wireless facilities on health or environmental grounds. The federal preemption leaves us in a situation today where Americans are clearly concerned about risks from antennas and towers, some face cognitive and physical health consequences, yet they and their families increasingly have no choice but to endure these exposures, while watching their real property valuations decline."

The National Institute for Science, Law, and Public Policy (NISLAPP) in Washington, D.C. was founded in 1978 to bridge the gap between scientific uncertainties and the need for laws protecting public health and safety. Its overriding objective is to bring practitioners of science and law together to develop intelligent policy that best serves all interested parties in a given controversy. Its focus is on the points at which these two disciplines converge.

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If you can support NISLAPP's work, please donate at the bottom of this page.

* * *

Commentary from ElectromagneticHealth.org:

Response to EMF real estate survey conducted by The National Institute for Science, Law and Public Policy:

ElectromagneticHealth.org suggests real estate agents and homebuyers be aware at this time that there are indeed perceived risks associated with real estate properties located in proximity to cell towers and antennas impacting both 1) interest in a given property and 2) a property's price.

Real estate agents are advised to:

1. Familiarize themselves with AntennaSearch.com to **be able to find antennas and hidden antennas** in a neighborhood,
2. Learn to work with an RF meter to **be able to competently assess a property and neighborhood** for RF electromagnetic fields from both external infrastructure sources and in-home devices,
3. Learn how real estate properties with high RF exposures can be physically **remediated or mitigated** (and when this is not practical),
4. Understand **at what distance from cell towers and antennas research is indicating biological and health effects**, including the increased incidence of cancer. (See cell tower studies in **"Some Studies Showing Cell Tower Health Impacts"**)
5. Learn the potential health consequences of the **new radiating utility meters**, called 'smart meters', and be able to identify and evaluate them.
6. Understand the special **importance of low RF in bedrooms**, from all sources, and especially in the bedrooms of children.
7. Be able to advise clients on **improving home safety from internal and external electromagnetic fields.**

Given there are over 220,000 cell phone towers in the United States, over 50 million wireless networks and untold numbers of antennas on or even inside buildings, and new risks from utility meters and the wireless networks that support them, real estate agents would best be conversant in the risks, and perceived risks, of electromagnetic fields. If ElectromagneticHealth.org can be of help to real estate agents, please do not hesitate to be in touch at info@ElectromagneticHealth.org.

Sources:
http://electromagnetichealth.org/electromagnetic-health-blog/survey-property-desirability/
http://electromagnetichealth.org/electromagnetic-health-blog/survey-commentary/