© Med Sci Monit, 2004; 10(7): CR336-340
PMID: 15232509

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Clinical Research

Received: 2003.11.05
Accepted: 2004.01.07
Published: 2004.07.02

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

Malignant melanoma of the skin – not a sunshine story!

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Source of support: Karolinska Institute, the Cancer and Allergy Foundation, SIF, TCO Development.

Summary

Background: In an earlier study on malignant melanoma incidence in Sweden, Norway, Denmark and the USA, we found a strong association between the introduction of FM radio broadcasting at full-body resonant frequencies and increasing melanoma incidence. The purpose of the current study was to review mortality and incidence data for malignant melanoma of the skin in Sweden and its temporal relation to increased "sun-traveling", and to the introduction of FM and TV broadcasting networks.

Material/Methods: Official, published information was collected and displayed graphically. These data included incidence rates of malignant melanoma, death numbers, charter travel statistics, and data on the expansion of the FM broadcasting network in all counties of Sweden.

Results: A good correlation in time was found for the rollout of FM/TV broadcasting networks while the increased amount of "sun travel" by air (charter) did not start until 7 years after the melanoma trend break in 1955. Counties that did not roll out their FM-broadcasting network until several years after 1955 continued to have a stable melanoma mortality during the intervening years.

Conclusions: The increased incidence and mortality of melanoma of skin cannot solely be explained by increased exposure to UV-radiation from the sun. We conclude that continuous disturbance of cell repair mechanisms by body-resonant electromagnetic fields seems to amplify the carcinogenic effects resulting from cell damage caused e.g. by UV-radiation.

key words: **melanoma • skin • UV • sun • radio • TV • broadcasting**

Full-text PDF: http://www.MedSciMonit.com/pub/vol_10/no_7/4321.pdf
Word count: 2482
Tables: –
Figures: 6
References: 20

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Background

Melanoma of the skin is a deadly disease. It is currently the fastest increasing cancer in Sweden, and also in many other countries. The main reason for this increase has been attributed to the "Western lifestyle," including increased travelling and a positive attitude to sunbathing and tanned skin [1]. In 1994, a consensus conference on the subject "Preventing the development of malignant melanoma" came to the conclusion that "The UV radiation from the sun is the only assured external cause for developing malignant melanoma of skin" [2].

In 2002, the present authors [3] concluded that there is an association between melanoma incidence and exposure to FM broadcasting radiation. Since increased exposure to UV radiation from the sun is the most commonly given explanation for the increase in incidence and mortality of malignant melanoma, we decided to take a closer look at the statistics about "sun travel," i.e. charter traveling to sunbathe and swim during vacation.

Material and Methods

Incidence rates of malignant melanoma of the skin were collected from several countries. The number of deaths caused by malignant melanoma during the 20th century in Sweden was collected from the WHO mortality database and Swedish death statistics. We also retrieved information on the development of charter traveling from Sweden and the expansion of the Swedish FM radio broadcasting network during the same time period. Charter travel basically developed to make it possible for ordinary people to fly abroad to virtually guaranteed sun and leisure in warmer countries. By comparing these sets of data, we intended to see if they were related in time, in a logical cause-and-effect order.

We collected all information on melanoma mortality, incidence and charter travel statistics by using data bases available on the Internet. The data was then analyzed and presented in various graphs, some of which are reproduced here.

Results

The incidence of malignant melanoma has increased dramatically in many countries during the last part of the 20th century. Figure 1 shows the development over time in several countries.

An even more drastic trend break can be seen in the development of melanoma mortality over time. Figure 2 shows the development of the number of persons in Sweden who died due to malignant melanoma of the skin. A drastic increase in the number of annual mortalities occurred in 1955 and continued further on. It is interesting to note that mortality shows the fastest increase in 1955, then slows down, while the incidence slowly picks up speed, reaching the fastest increase around 1980, i.e. 25 years later than the strongest acceleration in mortality. All data in this figure have been normalized to the data for 1988.

The Swedish Civil Aviation Administration (Luftfartsverket) [4] provides data that give a good measure of traveling habits

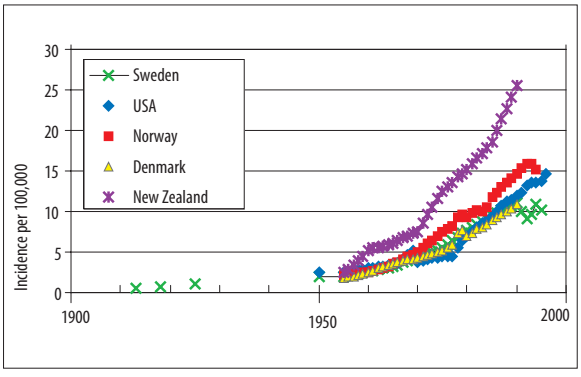

Figure 1. Melanoma incidence is accelerating in several countries.

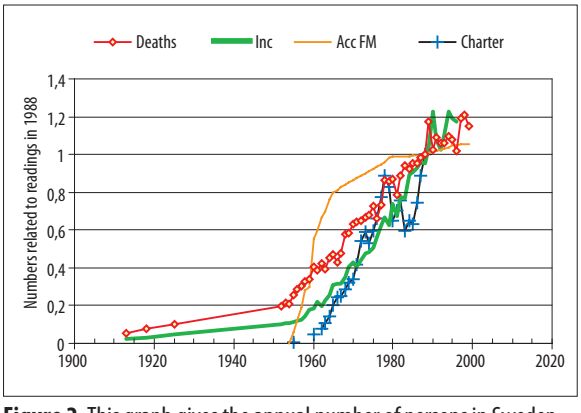

Figure 2. This graph gives the annual number of persons in Sweden who died due to melanoma of the skin, the annual number of new cases (incidence; inc), the annual number of charter flights made, and the accumulated number of persons covered by FM broadcasting; all data are normalized to the measured values from 1988.

in Sweden, i.e. the number of charter flights from Sweden to foreign countries over the years. Figure 2 also shows how the number of charter flights increased from 10,000 in 1955 to 1.4 million in 1988. The real start of this traffic did not take place, however, until 1962, when there were 0.1 million such flights.

FM broadcasting to the general population started in 1955, and the coverage was expanded over time, so that a major part of the country was covered during the 1970s. Figure 2 also shows the development of the total number of people who came to be exposed to electromagnetic fields with half-wavelengths of 1.5 m, or a frequency around 100 MHz.

Figure 2 shows that melanoma deaths increased sharply in 1955, while "sun travel" did not start in earnest until some 7 years later. This makes it quite unlikely that the melanoma deaths were caused by the increasing number of flights. Also, skin melanoma incidence starts a steady increase rather too early to support the hypothesis of a correlation. Thus the data do not support the "sun travel" theory.

Skin melanoma deaths increased by 22% (from 63 to 77 cases) in 1955, the same year the rollout of the FM and TV1 broadcasting networks began (see Figure 2). The death toll then increased steadily up until today.

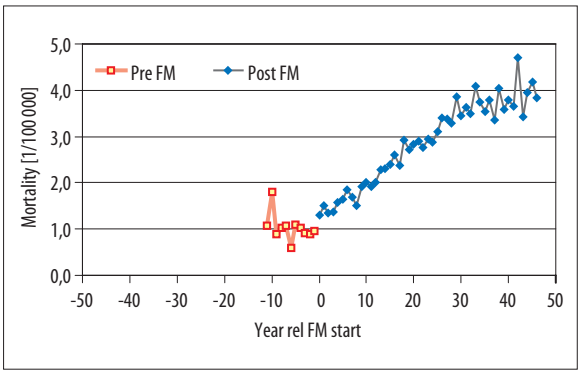

Figure 3. Mortality from malignant melanoma in the Swedish population relative to the time since or before the start of FM broadcasting in the different counties.

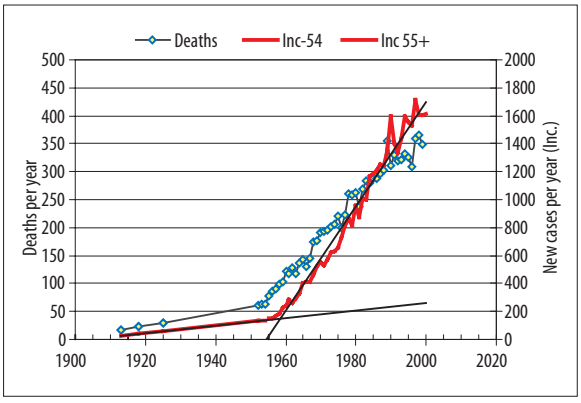

Figure 4. This plot shows that the melanoma mortality outbreak came about 5 years before an increase in melanoma incidence became obvious.

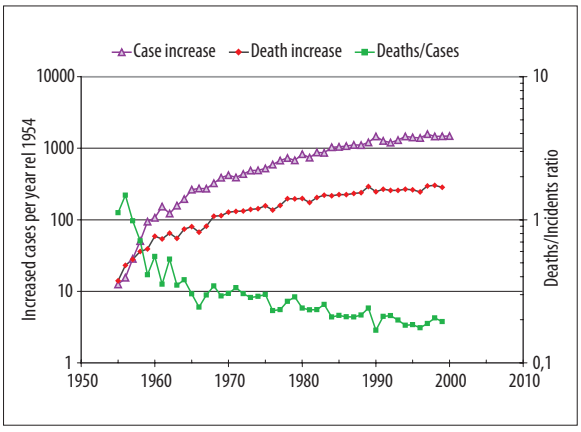

Figure 5. This plot shows the increase in annual deaths and new cases of melanoma reported in Sweden, as compared with the data from 1954. The ratio between deaths and reported new cases is added.

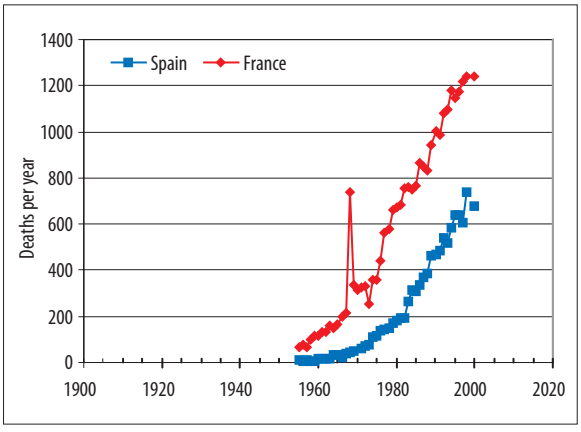

Figure 6. This plot gives the annual number of people who have died from melanoma of the skin in France and Spain since 1955.

It took over 10 years to reach full coverage of FM broadcasting in Sweden. This gradual introduction could make it difficult to notice trend breaks in the health status of the population caused by exposure to the new electromagnetic environment. It was possible, however, to get information about when different counties in Sweden had their first FM transmitting towers up and running. It was also possible to calculate the mortality in each county over time, and also to plot the total mortality relative to the time before or after the introduction of FM broadcasting in each county. The results of this analysis are shown in Figure 3.

The total number of new cases and deaths per year in Sweden due to malignant melanoma is shown in Figure 4, and the increase from the data for 1954 is shown in Figure 5.

A look at international statistics on melanoma mortality reveals a common pattent: melanoma mortality starts to increase drastically in the second half of the 20th century. An example is shown in Figure 6.

Discussion

Our findings may seem somewhat revolutionary to those who think that the sun is the only radiation source to be blamed for the contemporary plague of skin cancer. Here we shall first discuss our own findings, and then refer to other published work, in order to reach a better understanding of the possible mechanisms involved.

Malignant melanoma and electromagnetic fields

There can be no doubt that a relation exists between UV radiation and melanoma of the skin. Also, there is no doubt that UV radiation is a form of electromagnetic radiation that is capable of damaging cells in different ways. The depletion of the ozone layer over the last decades has become a cause for concern regarding skin and eye melanoma. But no strong increase in UV radiation due to ozone depletion was noticed as early as 1955. Consequently, there must be something else that suddenly accelerated the transformation of damaged cells into skin cancer.

Figure 3 shows mortality due to malignant melanoma in Sweden. The left side shows mortality in all counties before the implementation of FM broadcasting. Some counties had to wait for 11 years before they could enjoy FM radio broadcasting. The right side shows mortality vs. the time since the start of FM broadcasting. It is obvious that the mortality took a sharp upward trend break, from a flat, stable level

to continuously increasing numbers, beginning the same year FM broadcasting was introduced.

It has been argued [5] that mortality statistics are uncertain for several reasons, and it is recommended to use incidence data for exposure-response analysis. Our view is that a sudden change in environmental conditions might give a fast response in mortality (among all cancer patients who are still alive), while it may take several years before completely new cancer cases are caused by a new source of environmental stress. This is especially true if the environmental stress in question weakens the immune system, rather than directly causing the formation of new cancer cells.

We noticed that melanoma mortality increased suddenly from 1955 and onwards, while melanoma incidence initially increased more gradually over time, about 3 years later. This is shown in Figure 4. Normally it is expected that incidence should begin to increase first, and that mortality response would follow later on.

In Figure 5 we show the increase of annual deaths and reported new cases compared to the corresponding numbers in 1954. The death/incidence ratio exceeds 100% at the beginning, and goes down towards 20% in the year 2000. This is a clear indication that mortality among melanoma patients suddenly increased in 1955.

Our detailed study of cancer mortality in different countries shows that melanoma mortality started to increase drastically during the last part of the 20th century in many countries. Examples from France and Spain are given in Figure 6. Note that in the turbulent year of 1968 an additional 550 people died from melanoma of the skin in France. This extraordinary outbreak still lacks an explanation from the authorities.

Our hypothesis (ref. [3]) is simply that full body resonance effects, which easily occur in the 100 MHz frequency range, cause electric currents to pass through the body, sometimes for prolonged periods, e.g. during sleep at night. These currents may interfere with cell repair mechanisms that normally are supposed to clean up the body and repair damaged cells.

If such an impairment of the cell repair mechanisms was suddenly imposed on a given population, then it would be logical to expect that patients with advanced skin cancer would also show increased mortality from the same point in time. Such an increased mortality has been demonstrated not only in Sweden, as shown above, but also in Queensland [6].

There have been only a few reports on the influence of low-level radiation on skin cancer and malignant melanoma. A classic report is that of Dolk et al. [7], who found that "A significant decline in risk with distance was also found for skin cancer, possibly related to residual socio-economic confounding, as for bladder cancer." Recently, Tynes et al. [8] reported an association between calculated residential magnetic fields and cutaneous malignant melanoma: "Magnetic fields over 0.2 uT gave an OR around 2.5 compared with fields below 0.05 uT."

The effect of electromagnetic fields on cells *in vitro* and experimental animals

Today, a great deal of research has been done on the effects of EMFs on both cell structures and experimental animals, mostly rats. If the impact of low-level EMF exposure on skin cancer in rats were to be evaluated, one would have to use a corresponding wave-length. For example, GSM 1800 MHz would be useful for rats 7 cm in length. So far, however, no such experiment has been reported to specifically promote skin cancer in rats by low level resonant EMF exposure.

Haider et al. [9] investigated the effects of radio frequency (RF) EMF on chromosomes, and found that "Radiofrequency radiation in the immediate vicinity of broadcasting antennae yields moderate but statistically significant clastogenicity." Microwave exposure also affect sperm count, as stated by Weyandt et al. [10]: "The microwave exposed soldiers showed a significant decline in sperm count ($p=0.0085$)."

High-power radio stations may also increase leukemia according to a study by Michelozzi et al. [11], who found that "The risk of childhood leukemia was higher than expected for the distance up to 6 km from the radio station (standardized incidence rate=2.2) and there was a significant decline in risk with increasing distance both for male mortality and childhood leukaemia." A comparison of cows pastured close to and far from radio transmitters regarding the formation of micronuclei in bovine peripheral erythrocytes was done by Boscolo et al. [12]. They found that "cows in the vicinity of the transmitters had 0.6 micronuclei/1000 cells, while cows in the control group had 0.1/1000 cells; $p<0.01$."

Experiments have shown a clear impact of EMF at the cellular level. The effects of 50 Hz EMF exposure on apoptosis and differentiation in a neuroblastoma cell line was investigated by Pirozzoli et al. [13], whose data suggest "a possible role of 50 Hz and 1mT ELF-MF in interfering with regulation of the onset of differentiative and apoptopic processes of actively proliferating cells."

Cellular immunity was examined by looking into microwave irradiation and its effect on tumor necrosis factor production in mouse cells by Fesenko et al. [14]. They stated that "A significant enhancement of TNF production was found at 1 uW/cm^2. Further study is needed to elucidate the mechanism of the immunomodulating effects of microwaves."

Electromagnetic fields, the immune system, and well-being

Much of the research on EMF and health is today focused on mobile phone systems and handsets. Navarro et al. [15] demonstrated that "loss of appetite is the most relevant symptom that increases with exposure intensity from cellular phone base stations. Irritability, discomfort, fainting, difficulty in concentrating and fatigue also show a significant increment with exposure intensity ($p<0.05$)."

Stress hormones are affected by low-level RF EMF. According to Vangleova et al. [16], "Low-level exposures with specific absorption of 0.1127 J/kg caused significant increase in the 24-hour excretion of 11-OCS and disorders in its circadian rhythm were found in the exposed operators."

A good review of the biological effects of high- and extremely high-frequency electromagnetic fields was done by Mileva et al. [17], who found evidence that "non-thermal microwave effects do exist and may play a significant role."

Boscolo et al. [18] demonstrated that the immune system of women is affected by radio/television broadcasting towers. "The study demonstrates that high-frequency electromagnetic fields (ELMFs) reduce cytotoxic activity in the peripheral blood of women without a dose-response effect. Exposure to ELMFs induces a modification of immune parameters in humans."

Workers exposed to EMF and polychlorinated bisphenyls were compared in terms of prostate cancer mortality by Charles et al. [19], who stated that "The odds ratio (OR) for EMF exposed workers was 2 and for PCB 1.47. Non-white had EMF OR=3.67. There is an association between EMF and prostate cancer."

Ray and Behari [20] also measured the effect of low level EMF exposure on rats after 60 days, 600 uW, 7.5 GHz. They found that the exposed rats "tended to eat and drink less. It is proposed that a nonspecific stress response due to microwave exposure and mediated through the central nervous system is responsible for the observed physiological changes." It is interesting that both men and rodents seem to lose appetite when exposed to low-level radiation [15,20].

CONCLUSIONS

This brief study gives no evidence that increased travel is the main cause of increased mortality in malignant melanoma since 1955. We found, however, a strong connection between the start of FM broadcasting and increased mortality from malignant melanoma of the skin in all investigated countries. The fact that melanoma mortality starts to increase **earlier** than the incidence implies that an environmental factor other than sunshine affects the survival probability of melanoma patients. This is further underscored by the fact that melanoma deaths can show peaks of the kind noticed in France during 1968.

We believe this environmental factor to be radio frequency electromagnetic radiation, which is capable of (RF) affecting the proper function of cell repair and auto-immune system mechanisms in the human body. This conclusion is supported by other studies pointing at the effects that RF EMF may have on the immune defense system, cell repair, and apoptosis mechanisms.

The most important task now is to start action based on the knowledge already possessed, without waiting for another 20 years for more basic research. We need healthy ways of distributing high bit-rate communication to all homes, and new forms of mobile handsets, communicating without any hazardous effects on living cells.

Acknowledgements

The authors would like to acknowledge the support received from the Karolinska Institute and the Cancer and Allergy Foundation.

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