

> Radiation from Transmission Installations and Effects on Health

*Evaluation of scientific studies in the low dose range
Status: December 2012*

*Summary of the publication «Strahlung von Sendeanlagen und Gesundheit»
www.bafu.admin.ch/uw-1323-d*

> Summary

The status of scientific knowledge regarding potential risks to health due to exposure to high-frequency non-ionising radiation (100 kHz to 300 GHz) in the low dose range has previously been presented and evaluated in the past few years by the Federal Office for the Environment (FOEN) in two comprehensive reports. The term “low dose range” refers to intensities below the ambient limit values specified in the Ordinance relating to Protection from Non-Ionising Radiation (ONIR). The thermal effects of high-frequency radiation that occur at higher intensities are sufficiently well known and were therefore not the subject matter of those reports.

The initial evaluation of the status of scientific knowledge was made in the report called “Hochfrequente Strahlung und Gesundheit” (*Umweltmaterialien* No. 162), which encompassed studies carried out until the end of 2002 (SAEFL 2003 – not available in English). This evaluation was subsequently updated in June 2007 on the basis of studies that were published between 2003 and September 2006 (*Umwelt-Wissen* No. 0722, FOEN 2007 – the English version contains a summary only). These two reports were based on a total of approximately 350 experimental and epidemiological studies on human beings.

In the present report, the findings of the studies on human beings published in the period from October 2006 to December 2012 have been presented in summarised form and evaluated. Unlike the two previous reports in which studies that also included mobile telephones as a source of radiation were taken into account, in accordance with the mandate this latest report focuses solely on studies in which exposure to high-frequency radiation from fixed installations such as broadcasting transmitters and mobile telephone base stations was examined. In the past six years, approximately 50 studies on this type of exposure were published. These took the form of experimental field studies, epidemiological studies of population groups in their everyday environment, and experimental studies on short-term exposure under controlled conditions in the laboratory.

As was the case in the previous reports, the overall evidence for or against effects was evaluated on the basis of the findings of all studies. The various studies were systematically collected and evaluated by the ELMAR documentation centre of the Institute for Social and Preventive Medicine at the Swiss Tropical Institute in Basel. Detailed information concerning the individual studies may be obtained from the publicly accessible ELMAR database (<http://elmar.swisstph.ch>).

Findings regarding the effects of exposure to high-frequency radiation from fixed transmitters

In epidemiological studies, it has only been possible to satisfactorily record the individual exposure of human beings in everyday life to levels that arise in the vicinity of broadcasting transmitters and mobile telephone base stations since approximately

2007, because until that date the necessary measurement equipment and propagation models were not available. As a consequence, the quality of many of the studies has meanwhile significantly improved. However, there are still major differences in the methodological quality of the studies, and there are also some issues that have barely been examined to date.

The majority of the new studies on exposure from fixed transmitters concerned the occurrence of sleep disturbances and non-specific symptoms such as headaches, dizziness and nausea. With respect to **sleep disturbances**, several studies involving a shortwave radio transmitter had noted that such emissions could influence the quality of sleep of nearby residents, and this is the reason why this association was assessed as “possible” in the previous report. In the meantime, two field studies on this topic carried out in Austria and Germany have been published, as have the findings of the Swiss “Qualifex” study. The latter is the only study to date that not only carried out a cross-section analysis, but also went on to conduct a follow-up study one year later, and in which the individual level of exposure was not only measured, but was also calculated with the aid of a propagation model. Furthermore, for the evaluation of sleep quality, both information from participants as well as objective measurement data relating to body movement during sleep were available. The findings of all three new studies are more reliable than those obtained in the previous ones, because care was taken to ensure that the participants were not aware of their exposure status. This was not the case in the study carried out in the vicinity of a large shortwave transmitter. The findings of the new studies show that high-frequency fields from transmitters do not have any influence on sleep quality. Furthermore, no evidence was found that people with electromagnetic hypersensitivity react differently to exposure than the rest of the population. However, it is not yet possible to draw any definitive conclusions regarding this issue because not enough people have been studied to date over a longer time-frame. Moreover, in the new studies the actual differences in exposure were less pronounced than in the study on the shortwave transmitter, and the possibility cannot be ruled out that short waves give rise to other effects than those caused by present-day high-frequency electromagnetic fields, which mainly originate from mobile telephony, wireless telephones and wireless LAN.

For the previous report, only a handful of study results were available concerning the effects of high-frequency radiation from transmitters on **well-being** and **non-specific symptoms**. This issue has been the focus of research in the past few years, and in the meantime six experimental and eleven epidemiological studies have been carried out. In the experimental studies, effects of short-term whole-body exposure on well-being were only identified sporadically and did not give rise to a uniform pattern. From the epidemiological studies it is apparent that, in those studies with a more precise exposure estimate, no influence on well-being was observed as the result of exposure to high-frequency radiation. By contrast, there were some indications of associations in those studies in which only basic exposure estimates were made. Above all in studies carried out in the vicinity of individual large transmitters, the findings are limited in terms of relevance because, generally speaking, the participants were aware of their exposure status. Experimental studies have shown that awareness of exposure status influences the perception and description of non-specific symptoms. By contrast, blind studies in which the individual level of high-frequency exposure is measured or mod-

elled are less error-prone. However, in all studies to date the level of exposure was low, the differences between the studied groups were relatively minor, and the observation period was limited to one year. For these low levels of exposure the indications are that they do not influence people's well-being, but it is not yet possible to make a definitive assessment because observations have not been made over a longer timeframe.

The question whether weak high-frequency fields from fixed transmitters can be perceived was examined in five new experimental studies. As had already been found in earlier studies, on average the participants were unable to recognise the presence or absence of these fields with any degree of reliability.

With regard to the question whether people living in the vicinity of broadcasting transmitters or mobile telephone base stations are exposed to a higher **cancer** risk, four new studies have been carried out on children and six on adults. The new studies on the **leukaemia risk for children** encompassed larger collectives and applied better methods for estimating individual exposure than previous studies. Unlike some earlier studies, they do not indicate an association between exposure to fields from transmitters and the risk of childhood leukaemia. As a result of the high relevance of the new studies, the evidence for this association, which in the previous report was assessed as "possible", has been weakened. However, the level of exposure was also low in these studies, and the modelling of exposure levels from mobile telephone base stations was subject to some uncertainty. In view of this, it is not possible to draw any definitive conclusions with respect to the potential risk at exposure levels above 3 V/m.

With regard to the **risk of brain tumours in children**, too, the new studies do not point to any association with exposure to high-frequency radiation from fixed transmitters. Since the amount of data is smaller than that for the leukaemia risk, however, the assessment of the evidence is less reliable.

Of the new studies on the **cancer risk for adults**, four focused on exposure from mobile telephone base stations, and two on exposure from military or broadcasting transmitters. In contrast to the studies on children, the new studies on the cancer risk for adults suffer from a number of serious methodological shortcomings. These include uncertainties concerning the choice of study area, small case numbers, inadequate determination of exposure levels and a failure to take account of additional influencing factors. The fact that the collective was very heterogeneous in most of the studies (in some cases they encompassed both children and adults) is another weakness. In view of the significance of age as the most important cancer risk factor, this makes little sense. Due to these methodological shortcomings, none of the new reports meet the fundamental requirements placed on a scientific study. As before, it is therefore not possible to make a sound assessment of the evidence for or against an association between exposure level and cancer risk among adults.

To date, the effects of high-frequency fields on **physiological parameters** have primarily been studied in association with the use of mobile phones. Only isolated findings have been published concerning the lower whole-body exposure to fields from fixed transmitters. In particular, only one previous study has been carried out on the effects on the electrical activity of the brain. It appears that, for the majority of research

groups, the priority was to examine the existing indications of changes in electrical activity during intense local exposure of the head through the use of a mobile phone. In view of the small amount of data relating to whole-body exposure, at this time it is not possible to assess any potential effects of emissions from fixed transmitters. Similarly, **cognitive functions** such as learning processes or reaction speeds have primarily been examined to date in relation to exposure by mobile phones. The few earlier studies on whole-body exposure had produced contradictory results. In the four new experiments, no short-term effects on cognitive functions were observed. This means that the evidence is tending to weaken. However, no studies have yet been carried out on the effects of long-term exposure.

The effects on the **cardiovascular system** were examined in three new experimental studies, the results of all of which showed that there are no effects of short-term whole-body exposure on heart rate and blood circulation. Thus the findings of earlier studies were confirmed and indicate that short-term effects are unlikely. With respect to long-term effects, however, no studies have been carried out to date.

Very few studies have been carried out on the effects of exposure on **fertility**, miscarriage and premature birth rates, and congenital malformations. The only recent study was carried out in the vicinity of a military antenna and its findings are relatively unreliable due to methodological shortcomings. As before, because of insufficient data and methodological shortcomings in studies carried out in the past, it is still not possible to assess changes in **hormone balance**.

Conclusions

While the situation regarding data relating to the effects of whole-body exposure to radiation from fixed broadcasting and mobile phone transmitters has improved since the previous report, above all thanks to the introduction of propagation models and instruments for measuring individual exposure, due to the remaining uncertainties regarding the interpretation of the findings and existing gaps in knowledge it is still not possible to draw definitive conclusions.

The epidemiological studies show that, in the present-day environment, whole-body exposure to high-frequency fields from fixed transmitters is low. In these studies, only isolated cases of exposure above the level of 0.5 V/m were measured. Up to this level of exposure, the findings of the studies on human beings indicate no changes in physiological parameters or effects on wellbeing or health. From these studies it is however not possible to draw any conclusions regarding higher levels of exposure, for example with respect to the range of the installation limit values or the ambient limit values specified in the Ordinance relating to Protection from Non-Ionising Radiation (ONIR).

Higher exposure levels up to a maximum of 10 V/m were examined in experimental studies, and the findings did not point to any acute effects. The main strength of experimental studies is that confounding factors can largely be ruled out thanks to randomisation and the application of the double-blind principle. However, in most cases the duration of exposure was less than one hour, and this means that it is not possible to derive conclusions relating to long-term effects from these results.

By way of summary it may be stated that no new confirmed health effects of exposure to high-frequency fields from transmitters were observed in the dose range below the recommended reference levels of the International Commission for Non-Ionising Radiation Protection (ICNIRP), and thus below the ambient limit values specified in the ONIR. From the scientific point of view, this means that protection against acute effects is assured as before.

However, the epidemiological studies indicate often serious methodological weaknesses, especially with respect to carcinogenic effects, and no long-term studies have been carried out concerning the effects on sleep and wellbeing. In view of the fact that there are gaps in the available data, the absence of proof of health risks does not automatically also mean proof of their absence. From the scientific point of view, a cautious approach in dealing with non-ionising radiation is still called for. There remains a need for extensive research into the potential long-term effects. It also has to be assumed that exposure levels will change and increase further in the future due to the rapid development of wireless communication technology.