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# Executive summary

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In September 2003, TNO published the results of a study into the effects of controlled human exposure to GSM and UMTS-like electromagnetic fields on well-being and cognitive functions (the COFAM\* -study). Two groups of test subjects were studied. Group A consisted of individuals with health problems that they attributed to exposure to electromagnetic fields, usually from GSM base-station antennas. Group B consisted of individuals who had no such symptoms. Based on the study results, the TNO researchers concluded that the UMTS-like signal had an adverse effect on well-being in both groups.

In the present report, the Electromagnetic Fields Committee of the Health Council of the Netherlands gives its opinion on the scientific quality of the TNO study, at the request of the Minister of Public Health, Welfare and Sport. The Committee also makes proposals for replication and follow-up studies, in addition to answering questions on the definition of 'well-being' and on the consequences of a possible reduction in well-being.

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## Opinion with comments

The TNO report has evoked a number of questions from experts within the Committee and elsewhere. Before reviewing the TNO study, the Committee submitted what it felt to be the most important questions to TNO. Details of these questions, and of the responses

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\* *COgnitive Functions And Mobiles*; referred to in this report as 'the TNO study'.

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given by the primary investigator of the TNO study, are contained in an annex to this report.

On the basis of the TNO report and of the responses to its questions, the Committee concluded that the TNO study was of good quality, both in terms of design and execution. The Committee had some comments, however, regarding the interpretation of the data.

Exposure to GSM-900 or GSM-1800 electromagnetic fields had no effect on well-being in either experimental group. However, upon exposure to a UMTS-like signal, a small, but statistically significant increase in the well-being score was observed in both groups (a higher score indicates a decrease in well-being). This effect was found after only about half an hour's exposure to what, by everyday standards, was a relatively high environmental field strength. In practice, while individuals in the vicinity of operational UMTS antennas will be subject to continuous exposure, the field strengths in question will be lower. The results of the TNO study cannot be used to assess whether, and to what extent, there will be any effect on well-being in people's day to day environment.

There is some debate concerning the validity of the questionnaire that was used to measure well-being. Accordingly, it cannot be concluded that a change in the score obtained using this questionnaire reflects a real change in well-being. In the course of the TNO study, sufficient data was collected to allow a limited verification of the questionnaire's validity. The Committee recommends that this check be carried out.

Since the two groups of subjects exhibited several differences in terms of their composition, the respective sets of results cannot be compared directly. It is therefore impossible to say whether a given effect observed in both groups is the same or different.

When corrected for multiple exposures, the results of the cognitive function tests show a small but statistically significant difference between control and exposure for only one item: group B completed the memory comparison test faster during UMTS exposure than during sham exposure. It is not clear whether this result has any significance in terms of health.

The TNO researchers did not ask the test subjects whether they were actually able to perceive exposure or whether they believed that they could do so. Nor did they check this possibility.

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### **Replication required**

The Committee feels that there are good reasons for replicating the TNO study. Most importantly, the widespread exposure to such fields means that the results may well have implications for public health. The TNO study is an initial exploratory study in this area, and it also suffers from the statistical uncertainties inherent to experimental research. Replication studies will serve to further clarify the reliability of the results. These should

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be performed by researchers who are independent of TNO, under exposure conditions identical to those used in the TNO study. Some limited technical improvements to the design are acceptable, even desirable. These could include increasing the number of test subjects, and verifying whether they are capable of perceiving the presence of an electromagnetic field.

The Committee recommends that the original TNO questionnaire be used in the replication studies, in order to allow a proper comparison with the original study. At the same time, however, a validated measuring instrument for the determination of well-being should also be used. A degree of similarity between these sets of results would support the validity of the TNO questionnaire. The questionnaire itself should be expanded to include questions on the perception of electromagnetic fields, and on the improvement of well-being.

The Committee feels it important that the groups of test subjects with and without symptoms be as well matched as possible with respect to age, sex, and socio-economic status. This would allow a comparison to be made between the groups. The TNO study provides a basis upon which a detailed research hypothesis for replication studies can be formulated. This hypothesis should then be tested, using statistical procedures already set out in the study protocol.

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### **Follow-up studies advisable**

Partly on the basis of international consultations, the Committee concludes that there is a need for studies that simulate environmental exposure, as was the case in the TNO study. This has already been indicated in the Committee's report *Health Effects of Exposure to Electromagnetic Fields. Recommendations for Research* issued in February 2003. Of all the ongoing research projects being conducted elsewhere in the world, there is only one dealing with a situation that is comparable to living near a base station. All the other studies deal with exposure to mobile telephones. None of the currently available study descriptions mentions UMTS exposure. It is important that this area be further investigated. Indeed, since the TNO study indicated that UMTS exposure might well produce health effects, the Committee considers it essential that research be carried out into the effects of UMTS signals.

As a result of its present design, the TNO study leaves a number of questions unanswered. It also raises important new issues. The Committee therefore recommends that follow-up studies be carried out to address these matters. The above-mentioned recommendations regarding design improvements for replication studies are, of course, equally applicable to such follow-up research.

The important questions to be addressed in further studies include:

- Can it be objectively determined that some individuals are more sensitive than others to exposure to electromagnetic fields?
- Does the magnitude of any changes in well-being or cognitive functions in individuals who attribute their symptoms to electromagnetic fields differ from that in individuals without such problems?
- How do gender and age influence the effect of exposure?
- Is there a dose-effect relationship between exposure to electromagnetic fields and its effects on well-being and cognitive functions?
- How are these effects influenced by the duration of exposure?
- Do the effects of electromagnetic field exposure on well-being and cognitive functions differ according to the type of base frequency modulation involved? If so, what is the nature and magnitude of this effect?
- Does informing test subjects of the results influence their well-being? For instance, might those who experience such problems be reassured to know that symptoms were not experienced when exposure occurred in the context of the study?

According to the Committee and the expert it consulted, well-being can be scientifically assessed using well-designed questionnaires. The reliability of such measurements is dependent on the degree to which the questionnaires are tailored to the issue at hand. The Committee deems it essential that experts in psychology and psychometrics have an input into such studies.

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### **Decreased well-being does not inevitably have repercussions for health**

The Committee feels that a decrease in well-being is not necessarily a sufficiently severe health effect to justify mitigating measures. Any such action would depend on the extent of the decrease involved. A great deal naturally hinges on the way in which well-being is defined. The World Health Organization defines health as ‘a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity’. On the basis of this definition, any decrease in well-being should be considered an adverse health effect. However, the question is whether a minor decrease in well-being (for instance a degree of discomfort which does not lead to any mental or physical effects) should be considered an adverse health effect. The Committee’s position is that only when objective evidence is obtained of the generation or exacerbation of physical or mental symptoms, can it be said that a health effect is involved which requires mitigating measures.

The Committee takes the view that it is not possible, on the basis of the results of the TNO study, to determine the existence of a causal relationship between exposure to electromagnetic fields and decreased well-being or adverse health effects.

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