

INFORME SOBRE RADIOFRECUENCIAS Y SALUD (2016-2019)



1. EXECUTIVE SUMMARY

Once again, CCARS has published its triennial report to update the highest quality scientific evidence during the period from July 2016 to December 2019. The report conclusions confirm the evidence observed in the previous CCARS report regarding the scientific evidence to date, showing that there is no evidence of risk to human health under normal levels of personal exposure to RF EMF.

The text editing process was extended to March 2020 to include recently published changes to the ICNIRP guidelines on exposure to radiofrequency electromagnetic fields of 100 kHz to 300 GHz. CCARS considered it was worth delaying the issue of the report to incorporate them into the final text, due to the importance of the publication of these guidelines. In light of the new ICNIRP guidelines, the Ministry of Health, Consumer Affairs and Social Welfare and the Ministry of Economic Affairs and Digital Transformation will have to assess the importance of reviewing Royal Decree 1066/2001, based on the 1998 guidelines, to consider if any of its provisions need to be modified.

The methodology used to review the evidence is similar to that of previous reports: Once the studies have been classified according to their methodological quality, those that provide the highest quality of evidence, based on criteria accepted by the scientific community, are included. The scientific information (evidence) is obtained from clinical and epidemiological studies that provide the greatest weight of evidence, depending on the study design, methodology, quality, validity, consistency and reproducibility.

This report is not a systematic review or meta-analysis, but has followed a methodology similar to that of a scoping review (Manchado Garabito et al., 2009).

This edition of the report includes an extensive chapter dedicated to dosimetry and assessment of exposure to new 5G-based technologies and wi-fi systems.

Another new chapter reviews the scientific knowledge on electromagnetic field communication and risk perception.

5G technology is a set of novel use cases that go beyond traditional broadband mobile communication systems, and is expected to be directly involved in numerous sectors (e.g. telecommunications, industry, automobile, robotics and health), producing new economic models leading to a digital transformation of society for the most advanced countries.

The development of 5G services will involve massive deployment of new network components in Spain, either in locations currently used for other technologies and services or in new locations.

5G technology will use radio and network architectures that are more energy efficient and have lower level signals which, together with the decrease in cell sizes, are factors that would indicate lower exposure levels close to base stations. These features are accentuated in the case of 5G technology IoT devices, as they will communicate in very small periodic intervals of time and with very limited amounts of data, although a substantial increase in their number is expected. Thus, even wearable devices, close to the human body, with their low-power and short-duration transmissions, will involve very limited levels of exposure.

Exposure levels have to comply with the limits established in Royal Decree 1066/2001 and any changes to the new ICNIRP 2020 guidelines. The state is the competent body for establishing these exposure limits, and specifically the Ministry of Health (currently, the Ministry of Health, Consumption and Social Welfare). Control and inspection of the exposure limits is the competence of the current Ministry of Economic Affairs and Digital Transformation, through the Secretary of State for Telecommunications and Digital Infrastructures (SETID).

The normal exposure of schoolchildren to RF EMF due to wi-fi at school is lower than their exposure to other sources present in the vicinity.

Exposure in educational buildings, such as schools, universities and nurseries, is very low; with mean total exposure values in the range of 0.07–0.54 V/m. Similar levels of exposure were observed in other public buildings, such as airports, railway stations and shopping centres, with mean total exposure values in the range of 0.15–0.54 V/m. These results showed that exposure in all environments considered was well below the ICNIRP reference levels and those established in RD 1066/2001 for general public exposure (61 V/m).

The maximum mean exposure to the complete band of RF EMF was in offices (1.14 V/m) and public transport (0.97 V/m); while the lowest levels were in homes, with mean values in the range of 0.13-0.43 V/m. All of these are well below maximum allowed values.

A systematic review on exposure to RF EMF in the everyday environment in Europe and the key features of the various types of studies established that different approaches and procedures have been used in Europe which makes comparison between them more difficult. Exposure in homes is typically in the range 0.1-0.4 V/m with significant contributions from downlink/uplink (transmissions from/to a base station to/from mobile devices, respectively), mobile phones and DECT; with contribution from WLAN networks being relatively low. For better comparison between countries and to assess trends over time, a more harmonised approach across studies is needed.

A review of epidemiological cohort and case-control studies on the relationship between mobile phone use and brain tumours confirms that no increased risk is observed.

Analysis of trends in the incidence rates of CNS tumours over long periods of time can help to identify risk factors related to the etiology (causes) and prevention of the disease. No relationship is observed in Spain between the number of mobile phone users and the incidence of brain tumours, according to data published by REDECAN (Spanish Network of Cancer Registries).

Meta-analyses for the risk of cancer from epidemiological studies of the following tumours: head, malignant (gliomas), benign (meningiomas), acoustic neuromas, pituitary glands and salivary glands, compared with prolonged use (at least 10 years) of mobile phones does not show any increased risk. Although some case-control studies have reported significant increases in risk in people with moderate mobile phone use, these observations are not consistent with brain tumour incidence rates over time, despite increased exposure. The authors of a recent systematic review (2018) state the evidence for association of radio wave exposure with cancer risk has weakened since the IARC (2011) classification of RF EMF as 2b.

The latest systematic reviews by agencies and committees specialising in EMF risk assessment (SSM, 2019, Netherlands Health Council, 2016 and Italian Health Ministry

(Istituto Superiore de Sanita), 2019) agree that the results point to an absence of association between the use of mobile phones and an increased risk of tumours. A recent systematic review (Röösli et al., 2019) used current evidence from in vitro, in vivo and epidemiological studies and showed no association between mobile phone use and the development of tumours in the most exposed organs and tissues.

From the results of most of the studies reviewed, it can be deduced that no carcinogenic effect is observed from exposure to RF EMF at usual levels for the population.

Overall, the evidence reviewed confirms it is more plausible that the slight increase in glioma risk observed in some studies of intensive and long-term users may be a combination of chance, bias or confounders and the combined analysis of data, as the IARC itself established when it published its classification (2011) of the carcinogenicity from RF EMF emitted by mobile phones as 2b. This statement is consistent with the SCENIHR, which concluded in its latest systematic review (2015) that evidence of the relationship between glioma and mobile phone use is weaker since 2011.

Most agencies, committees and research groups agree there is still slight uncertainty about the long-term effects. Thus, due to the long latency periods of brain tumours, it is recommended that high quality, long-term prospective cohort studies with larger samples should be performed, especially in the assessment of individual exposure; with improved and accurate dosimetry in adults and children.

Experimental provocation studies with volunteers who claim to have an Idiopathic Environmental Intolerance attributed to electromagnetic fields (IAI-EMF) fail to demonstrate they are capable of detecting EMF when exposed to them.

Controlled clinical studies confirm there is no causal relationship between exposure to various RF sources and EH symptoms. There is no effect in clinical trials attributable to experimental exposure in volunteers reporting electromagnetic hypersensitivity. The nocebo effect and/or other mental or medical disorders may explain the symptoms in many individuals reporting IAI-EMF.

Newly published evidence also confirms that no adverse health effects are observed from exposure to RF EMF from mobile phone antennae, Radio/TV transmissions or wireless systems (wi-fi) used at work, school or home. Exposure levels observed in published studies are still hundreds or thousands of times lower than those considered unsafe by ICNIRP, WHO, EU and RD 1066/2001.

As the main creators and transmitters of information, communicators and journalists must have reliable and rigorous sources. The CCARS is at their disposal and responds to hoaxes and fake news as the primary source of information at the service of such professionals. Thus, when communicating risks or precautionary measures, balanced and rigorous coverage reflecting the current state of knowledge must be given.

Precautionary or preventive recommendations can increase the perception of risk; thus, the cost-benefit of the recommendation must be evaluated before it is made.

It is important to report common patterns and levels of exposure to RF EMF. Knowing these levels, referred to as the (ICNIRP) safety levels or the maximum levels legally permitted, can help reduce any risk, regardless of whether or not there is a question of possible harmful effects on health.

In recent months, the Ministry of Health, Consumption and Social Welfare, the Ministry of Science and Innovation and the Ministry of Universities, together with the Collegiate Medical Organisation, among others, have been making a great effort to denounce and react against pseudoscience and pseudotherapies.

To reduce the negative impact of false information, society must be provided with the most appropriate means and tools to disprove hoaxes, dismantle erroneous beliefs and disrupt the financial interests of those who take advantage of ignorance and fear about EMF.

The International Commission for the Protection against Non-Ionising Radiation (ICNIRP) published new guidelines in March 2020 for the protection of people from exposure to RF EMF in the frequency range of 100 kHz to 300 GHz [ICNIRP, 2020]. These replace the RF EMF part of the ICNIRP guidelines (1998), as well as the 100 kHz to 10 MHz (low frequency) part of the ICNIRP guidelines (2010).

Overall, the ICNIRP 2020 guidelines establish no more restrictive exposure levels than the 1998 ones. Additional restrictions have been introduced to take into account situations in which the ICNIRP (1998) restrictions did not adequately account for, due to the appearance of new technological developments since then, such as aspects related to 5G technologies.

1 CONCLUSIONS

Dosimetry and exposure assessment

New Radio Frequency Sources: 5G Networks

5G systems are not notably different from their predecessor, the 4G/LTE system, in terms of electromagnetic radiation. The greatest difference in the radio interface is in antenna techniques that will improve the user experience and promote new uses and applications.

However, there is a difference in the frequency bands used, since it is expected that 5G services in the future will be deployed in millimetre bands around 26 GHz. The same exposure limits apply for low and medium frequency bands (700 MHz and 3.6 GHz) as for traditional mobile broadband systems, and these are established by the ICNIRP guidelines. What really poses a challenge in 5G is the exposure measurement methodology, since the particularities of its radio interface mean that determinations must be adapted to measure as accurately as possible.

Wireless technologies and levels of exposure to RF EMF

The results of studies to evaluate exposure to wi-fi systems confirm that the average (typical) and maximum (peak) RF EMF exposure levels measured in nurseries and primary and secondary schools were of the order $10^{-4}\%$ and $10^{-2}\%$, respectively, of the ICNIRP reference level; that is, several orders of magnitude below it. The values obtained are in line with those obtained in previous studies and reviewed in the CCARS Report, 2013-2016.

Habitual exposure of schoolchildren to RF EMF via wi-fi at school is less than exposure to other sources present in the vicinity.

Exposure in educational buildings, such as schools, universities and nurseries, is very low; with mean total exposure values in the range of 0.07–0.54 V/m. Similar levels of exposure were observed in other public buildings, such as airports, railway stations and shopping centres, with mean total exposure values in the range of 0.15–0.54 V/m. These results showed

that exposure in all environments considered was well below the ICNIRP reference levels and those established in RD 1066/2001 for general public exposure (61 V/m).

The maximum average levels of exposure to this RF band were in offices (1.14 V/m) and public transport (0.97 V/m), while the lowest levels of exposure were in homes and apartments, with mean values in the range 0.13-0.43 V/m.

A systematic review on exposure to RF EMF in the everyday environment in Europe and the key features of the various types of studies established that different approaches and procedures have been used in Europe which makes comparison between them more difficult. Exposure in homes is typically in the range 0.1-0.4 V/m with significant contributions from downlink/uplink and DECT; with contribution from WLAN networks being relatively low. For better comparison between countries and to assess trends over time, a more harmonised approach across studies is needed.

5G technology will use radio and network architectures that are more energy efficient and have lower level signals which, together with the decrease in cell sizes, are factors that would indicate lower exposure levels close to base stations. These features are accentuated in the case of 5G technology IoT devices, as they will communicate in very small periodic intervals of time and with very limited amounts of data, although a substantial increase in their number is expected. Thus, even wearable devices, close to the human body, with their low-power and short-duration transmissions, will involve very limited levels of exposure.

Other wireless devices in commonly used bands

The norms on the use of the radio spectrum, both internationally and nationally, for wireless devices in commonly used bands (ISM or free), do not directly constitute a regulation on human exposure to electromagnetic fields. The power restrictions under the consideration of common use also imply protection against exposure to them. This is due to theoretical analyses and dosimetric experiments verifying that the values obtained from emissions in their normal operation are typically at levels well below the ICNIRP recommended reference levels.

Millimetre waves

The studies and study reviews carried out on millimetre and terahertz waves coincide in the analysis of their thermal effects as a fundamental effect of exposure to these frequencies of EM waves. For the analysis of biological effects, the number of studies carried out in these frequency bands is small and there are deficiencies in their methodology. An increase in the quantity and especially quality of these experiments is required (e.g. more rigorous dosimetric measurements, common exposure conditions for levels and time, temperature control and blinding).

With the most recent available studies, scientific and standardisation organisations such as ICNIRP (2020 recommendations) and IEEE (C95.1-2019 standard) have updated their exposure values in terms of recommendations and standardisation, respectively. From a technological point of view, the International Telecommunications Union (ITU) refers to the ICNIRP recommendations and agrees with the need to expand dosimetric and biological studies in millimetre bands. An increasing number of proposals from technology companies and communications operators are being heard to adopt statistical approaches for the evaluation of compliance with electromagnetic field exposure standards in new radio communications systems, with new technologies that involve diversity and antenna beam pointing. There should also be greater unification of criteria in national regulations with recommendations from scientific and standardisation bodies being taken as a reference.

Clinical and Epidemiological Studies: Review of the evidence of Brain and Central Nervous System Tumours

Current evidence from in vitro, in vivo and epidemiological studies does not indicate an association with mobile phone use and the development of tumours in the most exposed organs and tissues (Röösli et al., 2019).

- It can be deduced from the results of most of the studies reviewed that a carcinogenic effect resulting from exposure to radio waves at normal levels in the population is not observed.

- Some studies (Prasad et al., 2017, Bortkiewicz et al., 2017 and Yang M et al., 2017, Hardell & Carlberg, 2017) show a slight increase in gliomas and/or glioblastomas in long-term users. Another author (Wang Y) believes that the current evidence is of limited quality and quantity.

- Other studies that indicate an increase in tumour incidence rates suggest this was due to benign tumours (meningiomas) or glioblastoma multiforme (Philips et al., 2018), although this author considers that these studies provide little evidence and another study (de Vocht, F. 2019) doubts there is a causal relationship.

- Overall, the evidence reviewed confirms it is more plausible that the slight increase in glioma risk observed in some studies of intensive and long-term users may be a combination of chance, bias or confounders and the combined analysis of data, as the IARC itself established when it published its classification (2011) of the carcinogenicity from radio waves emitted by mobile phones as 2b. This statement is consistent with the SCENIHR, which concluded in its latest systematic review (2015) that evidence of the relationship between glioma and mobile phone use is weaker since 2011.

- Even if intensive mobile phone users had an increased risk of glioma, this would be very small and would be very difficult to detect in epidemiological studies, and much less in studies of the evolution of incidence rates and the annual number of primary CNS tumour cases.

- Systematic reviews by agencies and committees specialising in EMF risk assessment (SSM, 2019, Netherlands Health Council, 2016 and Italian Health Ministry (Istituto Superiore de Sanita), 2019) agree that the results point to an absence of association between the use of mobile phones and increased risk of tumours.

Radio wave health effects and Electromagnetic

Hypersensitivity (EH)

- There have been no significant changes in the published study results since the publication of the last CCARS report. EH is not included in the WHO International Classification of Diseases (ICD) and there is no protocol validated and accepted by the scientific community for the diagnosis and treatment of EH.

- A review of the bibliography confirms there is a lack of or insufficient information about actual exposure to RF EMF. Dosimetry continues to be one of the main weaknesses in epidemiological and clinical studies preventing relevant conclusions from being drawn.
- The exposure limits of new 5G technologies must comply with current limits and not exceed the limits considered safe by RD1066/2001.
- There is an association between people who have a high perception of risk and the appearance of subjective symptoms such as headache and back pain. More future research is required to elucidate and test the mechanisms underlying the apparent correlations between mobile phone use, headaches and other symptoms of health risk.
- Controlled clinical studies confirm there is no causal relationship between exposure to various RF sources and EH symptoms. There is no effect in clinical trials attributable to experimental exposure in volunteers reporting electromagnetic hypersensitivity. The nocebo effect and/or other mental or medical disorders may explain the symptoms in many individuals reporting IAI-EMF
- Newly published evidence also confirms that no adverse health effects are observed from exposure to RF EMF from mobile phone antennae, Radio/TV transmissions or wireless systems (wi-fi) used at work, school or home. Exposure levels observed in published studies are still hundreds or thousands of times lower than those considered unsafe by ICNIRP, WHO, EU and RD 1066/2001.

Review of exposure levels/recommendations of institutions and standardisation bodies

- Overall, the ICNIRP 2020 guidelines establish no more restrictive exposure levels than the 1998 ones.
- Additional restrictions have been introduced to take into account situations in which the ICNIRP (1998) restrictions did not adequately account for new technological developments, such as aspects related to 5G technologies.

- Existing restrictions have been modified to improve accuracy based on scientific advances since 1998, such as more precise knowledge about the relationship between the average spatial exposure and temperature increase.
- Restrictions have been removed in situations where it was clear no particular measure was necessary to provide protection against adverse health effects.
- The FCC considers that in light of the new evidence it is not necessary to modify the current exposure limits to RF EMF in the USA.

1 RECOMMENDATIONS

As few new developments have occurred since the publication of the previous report, the 2016 recommendations remain valid and CCARS recommends they be taken into account¹.

The next deployment of new 5G technology will require significant information and communication within society to understand what radio frequencies are, how they are used in everyday life and the mechanisms for ensuring compliance with exposure limits.

The Ministry of Economic Affairs and Digital Transformation and Ministry of Health should update the Royal Decree 1066/2001 to incorporate the new guidelines published by the ICNIRP (2020) and the methodological procedures for measuring exposure levels.

Consistent with the WHO, IARC, ICNIRP, EU and other agencies, international committees and research groups, as there is still slight uncertainty about long-term effects, and due to the long latency periods of brain tumours, it is recommended to carry out high quality, long-term prospective cohort studies with larger samples, especially in the assessment of individual exposure; with improved and accurate dosimetry in adults and children.

The financial resources necessary to investigate the effects of radio waves on health and its dosimetry and to improve communication should be increased in Spain. There should be greater international presence in research projects and in the activities of Agencies and Organisations competent in the risk assessment of EMF (WHO, IARC, EU, ICNIRP).

There are still some people who are uncertain about the consequences of the use of and exposure to new telecommunication technologies. This concern will lead to responses to reject the installation of new telecommunication infrastructure, thus hindering the development of new technologies (5G), the digitisation of the economy and the provision of quality services.

¹ See the current Recommendations in the annex

Collaboration and coordination should be increased between state, regional and local authorities and the sectors involved (e.g. Industry, Telecommunications operating companies, Professional Associations, Scientific Societies and Consumers) so that society knows and understands the methods used in the evaluation, management and communication of the effects of RF EMF. This collaboration must promote an open and transparent dialogue that facilitates objective and independent information, leading to the orderly implementation and development of new telecommunications technologies based on the best scientific evidence.

The competent authorities, especially the Ministry of Health, should carry out information and education campaigns on the effects of EMF, their uses, applications and the available systems to guarantee safe exposure. This information must be objective and based on the best scientific evidence provided by national and international agencies and organisations of proven experience, responsibility and competence.

Especially during childhood and adolescence, there should be information activities to promote the following: reasonable use of new telecommunications, (e.g. at school, problematic and excessive use, safety on the Internet and on social networks); respectful use with members of the public (e.g. privacy, use on public transport, leisure centres); and safe use (driving of vehicles).

Education is required to learn how to disprove hoaxes and false news, apply critical thinking, use official and reliable sources of information and not to spread unchecked information. Precautionary or preventive recommendations should take into account that they can increase the perception of risk, so the cost-benefit of recommendations should be evaluated before being made.

Monitoring systems for compliance with exposure levels and specific studies, reviewed in this report, on exposure levels to RF EMF in school, domestic, work and transport environments, confirm that these levels are much lower than those considered unsafe; thus, guaranteeing the protection of public health.