

Non-Ionizing Radiation

Non-ionizing radiation (NIR) refers to electromagnetic radiation with insufficient energy to ionize atoms or molecules. NIR includes the spectrum of ultraviolet (UV) light, visible light, infrared radiation (IR), microwave (MW), radio frequency (RF), and extremely low frequency (ELF) radiation. Radiation from wireless communication facilities, including cellular phones and networks, is within the radio frequencies⁽¹⁴⁾.

Numerous studies have examined the possible health effects of NIR. Exposure to radio waves can cause localized tissue heating. However, the main concern regarding the potential health risks of NIR focuses on the possibility that it has non-thermal effects.

The International Agency for Research on Cancer (IARC) classified ELF magnetic fields and RF electromagnetic fields as “possibly carcinogenic to humans” (Category 2B). Studies indicate an increased risk of developing leukemia (by a factor of 1.5-2) following prolonged residential exposure to magnetic fields (above 0.3-0.4 microTesla [μT], equivalent to 3-4 milliGauss [mG]). According to an IARC assessment from 2011, there is limited evidence supporting an increased risk of developing malignant brain tumors (glioma) and benign tumors of the auditory nerve (acoustic neuroma) among cell phones users.

A limited number of studies have assessed the possible association between exposure to RF and adverse health outcomes, such as fertility problems; impaired brain functioning; heart and circulatory system malfunction; hearing loss; changes in the secretion, composition, and flow of saliva; and neurodegenerative diseases. The results of studies that examined the effect of RF on sperm quality parameters are equivocal.

Policy and Regulations

The Ministry of Environmental Protection (MoEP) has the authority to determine environmental standards for NIR. The Ministry of Health (MoH), the Ministry of Education (MoEd), the Ministry of Communications, the Ministry of Energy, the Ministry of Interior, and the Ministry of Economy and Industry are also involved in developing and implementing policy on NIR. The Standards Institute of Israel (SII) is responsible for issuing Israeli standards for NIR emitting devices.

The 2006 Non-Ionizing Radiation Law includes requirements related to the installation and operation of energy-emitting sources, as well as requirements for monitoring NIR sources and publicizing the results. The law gives the MoEP the mandate to set maximum permitted exposure levels⁽⁷⁾. In 2011, the MoH and the MoEP recommended guidelines for maximal permitted levels of exposure to radiation from electric installations (10% of the thresholds defined by the International Commission on Non-Ionizing Radiation Protection [ICNIRP]). These recommendations have not been translated into regulations due to opposition by the Ministry of Energy and the Ministry of Finance. In 2015, an appeal was submitted to the Supreme Court demanding that the MoEP establish regulations regarding exposure to ELF. No progress on this subject has yet been achieved; the main stumbling block is a disagreement over the cost of implementing the regulations.

Following a government decision, the MoEP and the Ministry of Science and Technology established the Israeli National Information Center for Non-Ionizing Radiation (TNUDA) in 2013. The TNUDA Center collects and compiles scientific knowledge on non-ionizing radiation and its impact on public health, analyzes it, and makes it available to a variety of target audiences (the general public, government, researchers, and commercial enterprises). The Center recommends measures to reduce exposure to NIR and potential health hazards. TNUDA seeks to expand knowledge in this field and to guide the public in making educated decisions regarding the use of technologies involving NIR⁽¹³⁾.

In 2016, the MoEP published guidelines for reducing exposure to electromagnetic fields surrounding electric facilities. The guidelines include recommendations for planning and construction of power facilities, with an emphasis on passive and active protection technologies to reduce exposure to radiation, such as creating buffers between the magnetic fields and the protected area, or creating counter-magnetic fields to oppose the existing fields in the protected area⁽⁸⁾.

In recent years, several laws that restrict the use of cell phones among children have been proposed, including the prohibition on selling, marketing, and advertising cell phones to children under the age of 16. None of the proposed laws have been passed.

Policy on Exposure to NIR in Schools

In 2013, the MoEd issued guidelines stating that wired communication is preferable when using the internet in the classroom. If it is unfeasible to install a wired network, a wireless network can be installed, with the following limitations:

- Age limitations: The wireless network can be installed for grade 1 and upwards, but not in kindergarten. For grades 1-3, daily use is limited: for grades 1-2, up to one hour per day and not more than 3 days a week; for grade 3, up to two hours a day and not more than four days a week.
- A wired access point at the teacher's post should be installed in each classroom.
- Radiation measurements (RF and ELF) of school communications equipment and end-user devices should be conducted. The measurement should be performed by an authorized person, before and after installation, in order to ensure that radiation levels meet MoEP requirements.
- Schools should have educational programs about electromagnetic and RF radiation.

A circular published in 2016 by the MoEd limits the duration of digital learning and states that computers or tablets should be used only for pedagogical activities. It also limits the duration of electronic learning; for example, not more than 20% of the lesson in grades 1-3, and not more than 30% of the lesson in grades 4-6^(5,6).

Data on Exposure to NIR in Israel

According to data published by the MoEP, 1,005 ELF measurements were conducted in schools in 2014, and higher-than-recommended levels of radiation were found in 561 of them. In 2015, 346 of the 617 measurements conducted were found to exceed recommended radiation levels (Table 1)⁽⁹⁾.

Extremely Low Frequency (ELF) Radiation Measurements in Schools in Israel, 2014-2015

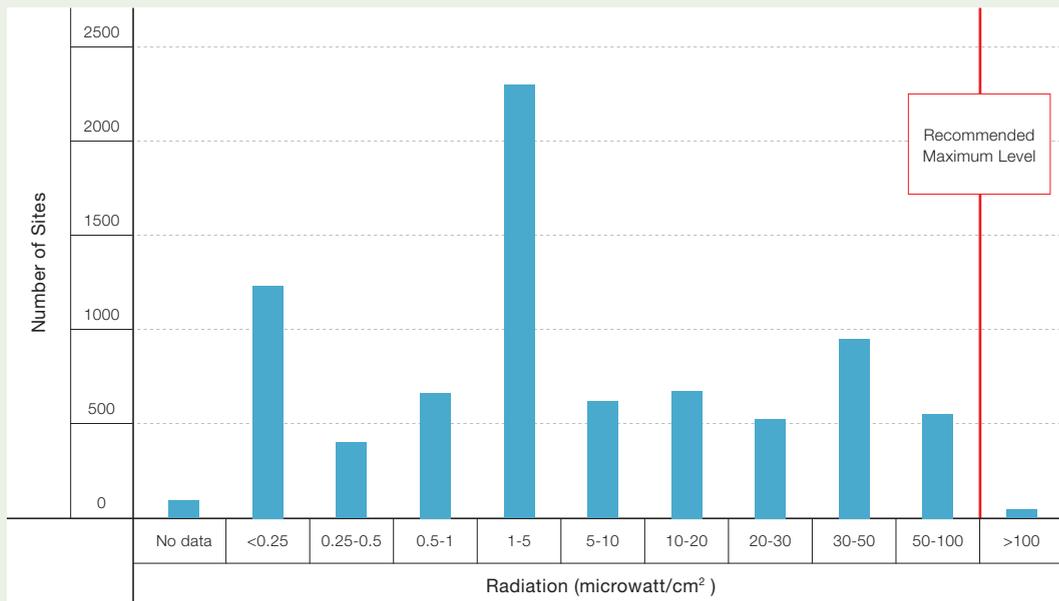
Year	Total Number of Measurements	Number of Measurements Exceeding the Recommended Radiation Level	Percentage of Measurements Exceeding the Recommended Radiation Level
2014	1,005	561	55.8%
2015	617	346	56.1%

←
Table 1
Source:
Israel Ministry of
Environmental
Protection⁽⁹⁾

The MoEP publishes the locations of RF monitoring systems and their measurements on the RF Monitoring System website⁽¹⁰⁾. The MoEP also tracks and monitors cellular antenna transmission in Israel. A report from early 2017 lists 7,950 active cellular transmission sites in Israel and provides data on their radiation levels (Figure 1). It should be noted that the radiation levels of 33 of the 7,398 antennas examined were higher than the recommended threshold of 100 microwatt/cm², but that the exceedances were measured in zones inaccessible to the general public.

NIR Levels at Active Cellular Transmission Sites in Israel, 2017

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Figure 1
 Source:
 Israel Ministry of
 Environmental
 Protection⁽¹⁰⁾



The Gertner Institute for Epidemiology and Health Policy Research conducted an educational intervention program and survey during the years 2012-2014 in central Israel, with the participation of eight schools, including 80 seventh and ninth grade classes. The findings indicated significant cell phone use among adolescents in Israel. For example, most of the students (96.1%) used cell phones on a regular basis, 27.8% spent more than one hour on voice calls daily, and 11% spent more than two hours on a typical day. About 28% reported receiving and sending more than 50 text messages per day and 7.4% reported more than 300 text messages per day. Most of the cell phone users (95.6%) began using a cell phone before age 12 (8.4% before age six), 30% reported that they answer phone calls inside elevators, and about 80% never use earphones or other hands-free devices while talking on a cell phone.

A survey conducted by one of the major cellular network operators in Israel found that 25% of children ages 6-8 owned a cell phone; this percentage increased to 66% among children ages 9-11.

Research on Exposure to NIR in Israel

Exposure to RF and Magnetic Fields

In 2015, researchers from the MoEP and Hadassah Academic College examined the effects of the transition to Long Term Evolution (LTE - a standard for very highspeed wireless communication for cell phones and data terminals) on exposure to RF. The researchers found that the transition to LTE decreased exposure to RF, despite an increase in the volume of transferred data, and that site sharing among operators can decrease the number of sites by 40% while also reducing exposure to RF.

Researchers from the Soreq Nuclear Research Center (NRC) conducted a national survey of radiation from various sources. In this study, published in 2015, the researchers measured ELF magnetic fields in ten models of gasoline, diesel, and hybrid cars, and found that the magnetic field in hybrid cars was the strongest, while the magnetic field in diesel cars was the weakest. According to this survey, the metal chassis of the cars may be a source of the magnetic field⁽³⁾.

In another study, which began in 2015, researchers from the MoEP and Hadassah Academic College quantified the exposure to LF magnetic fields in a train powered by diesel (instead of electricity). In such trains, electricity is produced by a diesel generator located in the locomotive, which in turn powers the electric motors that drive the wheels of the railcars. The researchers measured the radiation in the passenger seats and found a level of more than 6 μ T.

Health Effects of Exposure to NIR

The TransExpo Project (Childhood Leukemia and Residences near Electrical Transformer Rooms), which began in 2009, aims to evaluate the association between exposure to magnetic fields in the ELF range in residential areas and the incidence of leukemia among children. Seven countries, including Israel, are participating in this project.

Researchers from the Gertner Institute for Epidemiology and Health Policy Research are investigating the possible long-term health effects of magnetic resonance imaging (MRI), a medical technique used to diagnose a range of illnesses. During MRI procedures, the patient is placed inside a strong magnetic field, and is also subjected to radio waves. Health outcomes were examined in two different studies: The first aims to assess the possible effects of in utero exposure to MRI on neurodevelopment, future patterns of behavior, and hearing disabilities. The second study assesses the association between the exposure of children to NIR and the risk of cancer, using a large cohort of 260,000 participants, ages 0-17 years. This study was conducted in collaboration with the Research Institute of Clalit Health Services.

The international GERoNiMo (Generalized EMF [electromotive force] Research using Novel Methods) study involves 19 research institutes from 13 countries, including Israel. Launched in 2014, the study aims to close the knowledge gaps on the health effects of EMF and to identify ways to reduce exposure. The GERoNiMo study expands the objectives of the international MOBI-Kids epidemiological project, which examines the association between the use of cell phones and the risk of brain tumors in children and adolescents. It also uses personal questionnaires to expand the population sample and extend exposure assessment to include intermediate frequencies (in addition to ELF, RF, and other environmental factors already included in the assessment)⁽¹⁾.

Health Effects of Exposure to Electromagnetic Radiation from Cell Phones

A study published in 2016 by researchers from Tel Aviv University and the Rabin Medical Center aimed to evaluate the potential carcinogenic effects of radiofrequency energy (RFE) emitted by cell phones on human thyroid primary cells. The researchers examined thyroid cells that were

irradiated under different conditions that simulated the RFE emitted by cell phone, and found no carcinogenic effect on human thyroid cells or association between RFE from cell phones and thyroid cancer⁽¹²⁾.

The international INTERPHONE study was conducted in 14 countries, including Israel, from 2000 to 2007. This study aimed to determine whether cell phone use increases the risk of four types of tumors (glioma, meningioma, parotid gland, and acoustic nerve tumors)⁽⁴⁾. The results, published in 2016, suggest that tumor location is associated with the way cell phones are used. For example, more gliomas occurred closer to the ear on the side of the head where the cell phone was reported to have been used the most.

As noted above, the MOBI-Kids study is investigating the association between cell phone use and the risk of developing brain tumors among children and adolescents. Sixteen countries are participating in this international case-control study, including Israel, where 293 participants were recruited. The MOBI-Kids study uses personal questionnaires to address exposure to intermediate frequency radiation, in addition to RF, ELF and other environmental factors⁽¹¹⁾.

Progress Since 2014

In *Environmental Health in Israel 2014*, the major challenges noted concerning NIR were the publication or renewal of recommendations on maximum levels of NIR, and the regular monitoring of devices (such as transformers and power lines) in public spaces. Some progress has been made on both objectives.

Major Challenges

Despite some progress, there are still no binding regulations on the permitted levels of NIR in Israel. There is considerable research underway on exposure to NIR in Israel and its adverse effects, but further research in this field is needed, especially multidisciplinary research that includes biology, medicine, physics, engineering, epidemiology, and public health. The challenge will be to use the data generated from this research to improve health risk assessment and to pass this knowledge on to the public and policymakers.

There is low compliance with the MoH recommendations on reducing exposure to NIR (for example, using a speakerphone or earbuds). Increasing public awareness regarding the potential adverse health effects of NIR, and increasing compliance with recommendations to reduce exposure and potential risk, remain a major challenge.

In addition to exposure to NIR, there is increasing concern that the use of cell phones, tablets, and other communication devices may have other indirect adverse health effects,

especially among children⁽²⁾. These effects, which are unrelated to radiation, include addiction, social problems, psychological effects, sleep disturbances, and obesity. The TNUDA Center addresses these issues in its research program. However, there is a need for formal government recommendations and guidance, especially regarding children.

The Ministry of Energy's Smart Cities Administration aims to apply information and communication technologies in local government to improve administrative, regulatory and economic aspects. Expanding the coverage of wireless internet networks in cities and wider use of RF communication may increase the public's exposure to electromagnetic fields. In addition, there are plans to convert household water and gas meters to wireless smart meters. This may further expose the public to RF fields. The potential impact of Smart City technology and smart meters on the public's exposure to NIR has yet to be evaluated.

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