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## Measuring exposure of workers in MRI environment



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Magnetic resonance imaging (MRI) facilities are important sources of multiple exposure to electromagnetic fields for both patients and healthcare staff. In an exploratory study, researchers conducted an exposure assessment and biomonitoring of MRI workers at the Radio-diagnostics Unit of the National Cancer Institute of Naples "Pascale Foundation" (Naples, Italy). In particular, exposure to the MRI static magnetic field (SMF) has been evaluated by means of personal monitoring, while an application tool has been developed to provide an estimate of motion-induced, time-varying electric fields.

The study results show a high day-to-day and worker-to-worker variability of the exposure to the SMF, which strongly depends on the characteristics of the environment and on personal behaviours. Further, the developed application can be adopted as an easy-to-use tool for rapid and qualitative evaluation of motion-induced, time-varying electric field exposure.

Due to the increasing use and technological advancements of MRI systems, clearer insights into exposure assessment and a better understanding of possible harmful effects due to long-term exposures are highly needed. In this paper, possible approaches for exposure assessment and biomonitoring of workers routinely exposed to the SMF and motion-induced, time-varying electric fields of a 1.5 T MRI system have been proposed.

Researchers evaluated exposure to the SMF by personal monitoring of workers through wearable dosimeters. The exposure level never exceeded the 2 T limit value defined by the European Directive 2013/35 for normal working conditions (as expected for a 1.5 T MRI scanner), although a high day-to-day and worker-to-worker variability of exposure was recorded, with, on average, higher exposure levels recorded for MR technicians than for the medical doctor and the nurse, as reported also by previous work.

"The movements of workers in a spatially heterogeneous SMF can result in exposure to low frequency time-varying electric fields, inducing electrical currents within the body. These motion-induced, time-varying electric fields may cause transient symptoms, such as dizziness, vertigo, nausea, tinnitus, and concentration problems, which are annoying for the worker and can impair the regular working activity," the researchers point out.

The assessment tool is provided with a graphic user interface, which is user-friendly for non-expert users, which can define a walking path on the magnetic field map, associate a walking speed to the movement (with a trapezoidal velocity profile), and calculate dB/dt, induced electric field, and current density.

Regarding biomonitoring, the 24 workers of the Radio-diagnostics Unit were enrolled to evaluate both spontaneous and mitomycin C-induced chromosomal fragility in human peripheral blood lymphocytes, by means of the cytokinesis-block micronucleus assay. The study subjects were 12 MRI workers, representative of different professional categories, as the exposed group, and 12 workers with no MRI exposure history, as the reference group.

The results show a high worker-to-worker variability for both field exposure assessment and biomonitoring, as well as several critical issues and practicalities to be faced with in this type of investigations, according to the researchers.

"The procedures for risk assessment and biomonitoring proposed here can be used to inform future research in this field, which will require a refinement of exposure assessment methods and an enlargement of the number of subjects enrolled in the biomonitoring study to gain robust statistics and reliable results," the authors note.

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