

## Spotlight on EMF Research

# Spotlight on “Measurement studies of personal exposure to radiofrequency electromagnetic fields: A systematic review” by Ramirez-Vazquez et al. in Environmental Research (2023)

Category [radiofrequency, dosimetry/exposure]

Spotlight - Jun/2024 no.4 (Eng)

Competence Centre Electromagnetic Fields (KEMF)

## 1 Putting the paper into context by the BfS

Modern mobile communication systems emit radiofrequency electromagnetic fields (RF-EMF) into the environment. In parallel with advances in technology, the number of RF-EMF emitting devices is growing, and the infrastructure is expanding, which constantly adds more complexity to the actual exposure of the general public. Personal exposure measurements can provide information on exposure levels in realistic scenarios.

## 2 Results and conclusions from the authors' perspective

The authors have provided a systematic review of available studies conducted between 1998 and 2021 that recorded personal exposure [1]. The objective of the review was an assessment of the exposure of the general public. Hence, studies were retrieved that provide descriptive data on personal exposure measurements that were conducted by volunteers or trained researchers in microenvironments. Using a multiple adjusted set of keywords and search strategies, the authors performed a search in the Web of Science database and identified 1782 studies, out of which 56 studies were included in the review. The search and inclusion process was documented in a PRISMA (acronym for Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart. For defining eligibility criteria, the authors applied the PECO approach (acronym for Population, Exposure, Comparator and Outcome) and confirmed the legitimacy for the inclusion of studies by using the CASPe tool (acronym for Critical Appraisal Skills Programme Español).

In the vast majority (83%) of the included studies, body worn personal exposimeters were used to record ambient EMF levels. For all included studies, the authors tabulated the mean and median as well as minimum and maximum power flux densities, where these statistical metrics were given in the respective study (E-field values were converted into power flux densities using a far field formula). The results illustrate a high

heterogeneity in measured exposure levels. The reported average power flux densities vary between 1 nW/m<sup>2</sup> and 285 mW/m<sup>2</sup>. The majority of the studies report mean values below 1 mW/m<sup>2</sup>. The median values range from 60 nW/m<sup>2</sup> to 403 mW/m<sup>2</sup>. The authors consider these values to be in line with reported values in other systematic reviews. They conclude that the RF-EMF exposure level of the general public does not change strongly over time and is well below the ICNIRP reference values.

### 3 Comments by the BfS

High data quality and large sample sizes are prerequisites to characterise the exposure of the general public as comprehensively as possible and to also cover rare exposure scenarios. If the measurement methodology is consistent over the years, it may even be possible to monitor temporal trends. To do so, a review of systematically selected and analysed exposure studies can be a very useful approach. It allows increasing overall sample size if sufficient comparable studies of high quality are available. However, it is doubtful that the methodology of the systematic review by Ramirez-Vazquez et al. is robust enough to draw reliable conclusions about the exposure of the general population.

Although the methodology is supposedly "based on the PRISMA statement", the paper only loosely adheres to these guidelines and the search strategy does not appear to have been fully and clearly derived from the PECO elements and the eligibility criteria. In addition, the search query printed in the article contains formal errors such as missing parentheses to separate the PECO components population, exposure and outcome. Other relevant search terms, synonyms, alternative spellings, abbreviations and truncations to account for singular and plural are missing. The limitation of the search to a specific research area is also questionable. As a result, the recall and precision of the search strategy are likely to be very low. The limited information provided in the paper is not sufficient to replicate the search and to obtain the same results, as intended by the PRISMA guidelines. Besides, the stated eligibility criteria are, in part, not entirely clear. For instance, this systematic review focuses on the exposure of the general population as a whole, but the search only contains the population-related keywords "Children" and "School". While this could strengthen the requirement for a complete representation of the general public including young persons and pupils, it might also lead to an under-representation of relevant studies, where schools are not specifically highlighted as microenvironments within the study metadata. The fact that studies listed in other reviews had to be subsequently added to the pool of identified and screened publications, provides strong evidence that the search methodology was insufficient. Further, the PECO approach has been originally developed to systematically assess studies on health-related outcomes, but such studies are not in the scope of this systematic review. Additionally, the authors applied the CASPe tool (for critical appraisal of systematic reviews, cohort and case-control studies) in order to verify the inclusion of the 56 exposure studies, a purpose for which the tool was not designed. Therefore, it remains doubtful if the systematic inclusion and exclusion of studies in this review was adequate, considering the approach applied by the authors.

The weakness of the approach is illustrated by the inclusion of a study of workers in close proximity to strong broadcasting transmitters [2], showing the highest median power density of all included studies. Contrary to the aim of the review, this study is not relevant for the exposure of the general population, but of the occupational population. In addition, the inclusion criteria required studies to provide descriptive data of exposure, but two of the 56 included studies did not provide statistical values such as mean, median, minimum or maximum, which casts further doubt on the robustness of the inclusion/exclusion procedure.

In their analysis, the authors do not differentiate between far field and near field exposure, although local and whole-body exposure levels cannot be directly compared. Besides, in the near field, a power density cannot be reliably calculated from the electric field strength using a far field formula, as done by the authors. For example, the study that provided the highest mean exposure level [3] is, in fact, a study that assessed

the electric field within a few centimetres of an emitting mobile phone, which is inappropriate for assessing whole body exposure.

In summary, the present systematic review by Ramirez-Vazquez et al. does not provide further insight into the exposure of the general population to RF-EMF. Other systematic reviews, such as Jalilian et al. 2019 [4] and Sagar et al. 2018 [5], provide a much more rigorous and methodologically robust overview, despite the inclusion of a smaller number of studies, which however, is partly due to reasonable exclusion criteria, such as the exclusion of studies with the distorting influence of near field sources.

## References

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## **Impressum**

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[urn:nbn:de:0221-2024061944447](https://nbn-resolving.org/urn:nbn:de:0221-2024061944447)

Spotlight - Jun/2024 no.4 (Eng)