



## Comments on “Wi-Fi is an important threat to human health”



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## ABSTRACT

This correspondence refers to the Environmental Research article by Martin L. Pall entitled "Wi-Fi is an important threat to human health". Author presented a biased review about 7 potential effects of Wi-Fi exposure. Most of articles cited are in vitro or in animals and lab conditions, not in humans. In this letter to the editor I analyse the articles cited in Pall's work in order to demonstrate that neither the conclusions nor the title are appropriate.

Given the interest of the subject and the controversy existing in several countries, such as France or Malta, also in Spain, on the possible effects that Wi-Fi could have on human health, I read with great interest the article by Martin L. Pall entitled "Wi-Fi is an important threat to human health" (Pall, 2018).

The author of this work provides a series of evidences to demonstrate the threat that Wi-Fi networks pose to human health. For this purpose, it carries out a review of articles without a detailed methodology, inclusion or exclusion criteria, neither temporary, search keywords, etc., which results in the inclusion of a biased and interested series of inadequate articles to prove his thesis. It focuses mainly on 7 effects: oxidative stress, sperm and infertility, neuropsychiatric and neurological effects, cellular DNA damage, Calcium overload, endocrine changes, and cellular apoptosis. Likewise, it provides a detailed list of non-thermal effects with a no less numerous list of articles and reviews, in almost every occasion includes his own works (8 papers cited 28 times along the text). From the careful analysis of the bibliography provided, it appears that no articles have conclusive effects on human effects. In the worst case, he refers to parts of the Bioinitiative report that has been questioned for its bias.

Finally, Pall criticizes the Foster and Moulder systematic review in Health Physics (Foster and Moulder, 2013) referring to it in the introduction as “Telecommunications industry-linked individuals and groups have claimed that there are no and cannot possibly be any health impacts of Wi-Fi” and including in the same citation a text published in The Baltimore Sun, what does not seem appropriate. Nor does it seem very appropriate to summarize his own work in the introduction as "This paper is not focused on anecdotal reports but rather on 23 controlled, scientific studies of such health-related effects in animals, cells including human cells in culture and in human beings.

Pall reviews 7 possible effects of 2.4 GHz radiofrequency radiation (Wi-Fi), namely: DNA damage, effects on sperm and fertility, neurological and neuropsychiatric effects, apoptosis or cell death, overload of the channels of Calcium, endocrine effects and oxidative stress. As I have indicated, by not having inclusion and exclusion criteria or methodology, Pall includes those articles that are suitable for his thesis, which is not correct because, obviously, it is biased and makes a partial analysis clearly interested.

In addition, to justify the 7 effects studied (Table 1 of the article) 42 citations are included, but really many duplicate articles that are valid

for several effects, because, in reality, there are 23. Finally, and most importantly, studies are mixed with different approaches that should be treated with care: in vitro and in vivo studies, which are mixed with studies in cells, in animals and, very few, in humans. While the title of the article is clear “important threat to human health”, only 3 of the 23 articles included in Table 1 are of human studies.

In the case of the effects on sperm and infertility, effects should exclusively be included in humans (or human cells), but of the 8 articles cited in this section, only 1 was in humans (Yildirim et al., 2015) based on anonymous questionnaires. It is not an adequate study to conclude any possible effect of exposure to Wi-Fi in humans since no other variables were controlled (food, air pollution, antecedents, previous pathologies ...). Even, the sample was obtained from an infertility clinic and there was no control group and the authors claim that no differences were found. The rest of citations are to in vitro experiments, or in animals under experimental conditions and away from reality.

The same, or worse, happens in terms of the effects of oxidative stress. The 11 articles cited are in rats or in vitro, none in humans. In the section about neurological effects, 5 studies were included, 4 in rats and 1 in humans (Papageorgiou et al., 2011), in which a sample of 30 people, 15 men and 15 women, was available, in which they wanted to show differences between sexes in a Hayling sentence completion test in the presence of Wi-Fi. Experiments were done in a Faraday cage instead of an anechoic chamber. Results decreased for males and increased for females during exposure while performing a Hayling Sentence Completion task.

About apoptosis effects, 4 studies are included, 3 in rats and 1 in vitro (Çiğ and Nazıroğlu, 2015), with human cells in which they find differences but only if the exposure was carried out at distances less than 10 cm from the cells that were irradiated for 1 h, without indicating the exposure values reached. Between 20 and 30 cm the authors indicate that there were no differences and indicate that more than 10 cm would be enough to protect the cells.

About effects on DNA only 3 studies are included, none in humans and all of them included in previous sections. The same happens with the overload of the Calcium channels, including 3 studies already mentioned above. And, finally, regarding to the endocrine effects of the 3 articles cited, only 1 is new with respect to those included in the previous sections and, surprisingly, it is not human either, but in rabbits.

Other effects are included in which either articles cited above are mentioned again, or they are in animals, none, again, in humans.

In Table 2, a variety of articles are included in a “review of non-thermal effects of microwave frequency EMF similar to those found in multiple wi-fi studies”. A mix of articles and reviews, many of them in animals, in vitro and at different frequencies than Wi-Fi, publications since 1971, reports, books and a series of recent works by Pall.

Finally, in Table 3, the author details probable mechanisms, that do not possible mechanisms, based on voltage-gated calcium channels (VGCC) that would justify his hypothesis. A list of mechanisms that is not supported by a complete and adequate bibliographic references and, in the case of offering them, are studies at different frequencies than Wi-Fi, once again, no conclusive studies in humans.

Finally, in section 9, the author makes an unjustified and unfounded attack on the work of [Foster and Moulder \(2013\)](#). A systematic review with a clear methodology in comparison to Pall’s article. In which in vitro studies of exposure studies are separated. In their conclusions, authors indicate that “on the biological studies of Wi-Fi are to be done, they should be done in vivo, with endpoints that have a plausible connection to human health risk” and “The model systems chosen should take into account the limited penetration of Wi-Fi signals in the body; there is little point in evaluating organ systems in rats or mice that are too deep in humans to receive any real exposure from a Wi-Fi device”.

In conclusion, from the title to the conclusions of Pall’s article are not based on adequate evidence. A dangerous extrapolation of some in vitro and animal findings is carried out, even at frequencies and levels of exposure very different from those provided by Wi-Fi networks, to warn about unlikely effects on human health that, in any case, the evidence would justify how “an important threat”. At the usual

exposure levels ([Sagar et al., 2017](#)), it does not seem appropriate to think about any biological effects due to the low penetration of Wi-Fi waves, so the publication of this frightening article, can be misinterpreted by part of society concerned, even at pathological levels, by this type of technology. The errors, bias, a non-existing methodology, the interested choice of the articles, as well as the conclusions not based on human evidences, indicate that it is an intentional academic misconduct, so I ask for the retraction of this article by the journal.

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