

Title: Media manipulation of information on the health effects of 5G? A small-sample case study of the Croatian news website Index.hr

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ABSTRACT

A history of research on radio frequency radiation, and recent scant research on the newly emerging 5G suggests that the expansion of 5G poses a possible public health issue. The media play a decisive role in how the public responds to a public health issue, and what it knows about it. However, there is an increasing amount of misinformation on health topics in the media. The present case study investigated whether the Croatian news website Index.hr manipulates information on the health effects of 5G. We constructed one experimental corpus, containing all articles by Index.hr on health effects of 5G, and two control corpora, one with articles about health effects of 5G published by reliable mainstream media, and one with articles about science (but not 5G) published by Index.hr. We assessed the presence of references, scientific references, misinformation, opinion expression, and opinion subjectivity. Compared to Index.hr science articles, Index.hr 5G articles were 10.78 times likelier to contain no references, 4.20 times likelier to contain no scientific references, 10.78 times likelier to contain misinformation, 288.14 times likelier to express the author's opinion on the issue, and 16.95 times likelier to express a subjective opinion. The simultaneous increase in misinformation and reduction in referencing suggests that misinformation doesn't stem from other unreliable sources of information, but that the misinformation is produced within Index.hr. An increase in opinion expression, and opinion subjectivity in the context of misinformation suggests that Index.hr is manipulating the information on health effects of 5G. This is corroborated by the fact that the two types of misinformation identified in the present study included erroneous referencing, and denial of the existence of

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scientific literature on the topic. Furthermore, all articles on both 5G, and scientific topics were written by different authors, indicating that this phenomenon is systematic within Index.hr. We conclude that our data point to a manipulation of information on health effects of 5G by Index.hr. Still, the small sample size warrants a degree of caution.

1. INTRODUCTION

The expansion of wireless information and communication technologies using electromagnetic fields has exploded in the last couple of decades. Once limited to particular social and/or geographical groups of people, these technologies have become practically omnipresent and they have been systematically incorporated into everyday functioning. Currently, the new generation of wireless information transfer – the 5G – is expected to be globally introduced. It is predicted that 5G will provide faster and more extensive data transmission through the use of additional higher frequency bands (Simkó & Mattsson 2019: 1). Thus, 5G has been welcomed by a multitude of interest groups, however, many have expressed their concerns about its possible adverse effects on human health. While some of these concerns have been assumed unconvincing and/or categorized as “conspiracy theories”, some of them have been raised by scientists and published in reliable sources.

There is a far-reaching history of research on the health effects of wireless radiation (Belpomme et al. 2018; Desai et al. 2009; Di Ciaula 2018; Doyon & Johansson 2017; Havas 2017; Kaplan et al. 2016; Kostoff & Lau 2013, 2017; Lerchl et al. 2015; Levitt & Lai 2010; Miller et al. 2019; Pall 2016, 2018; Panagopoulos 2019; Panagopoulos et al. 2015; Russell 2018; Sage & Burgio 2018; Van Rongen et al. 2009; Yakymenko et al. 2016). Kostoff et al. (2020) summarize these findings reporting that exposure to radio frequency radiation below the American Federal Communications Commission guidelines can result in the genesis of several types of cancer, DNA and chromatin damage and/or dysfunction, mutagenesis, teratogenesis, neurodegenerative and neurocognitive disorders, reproductive problems, excessive reactive oxygen species/oxidative stress, inflammation, apoptosis, blood-brain barrier disruption, pineal gland/melatonin production dysfunction, sleep disturbance, headache, irritability, fatigue, concentration difficulties, depression, dizziness, tinnitus, burning and flushed skin, digestive disturbance, tremor, cardiac irregularities, and general dysfunction of the neural, circulatory, immune, endocrine, and skeletal

systems. Specific research on the health effects of 5G has been scant. Nevertheless, the majority of the existing literature demonstrates that exposure to 5G has biological effects on humans which can be interpreted as adverse health effects (see Simkó & Mattsson 2019 and papers cited therein). Kostoff et al. (2020) predict that exposure to high-band wireless radiation as used in 5G would be associated with skin and eye diseases with probable effects on the nervous system, heart, and the immune system (cf. Mehdizadeh & Mortazavi 2019). Interestingly, a recent review on the effects of 5G found no relationships between the effects of exposure, and intensity, exposure time, and frequency (Simkó & Mattsson 2019: 16). Be as it may, there is no scientific consensus on the health effects of 5G, mainly because this topic remains understudied, the existing studies employ heterogeneous methodologies, and the methodology in this field is severely limited. As discussed by Kostoff et al. (2020), most studies have been conducted in laboratory settings, which implies predominant use of animal compared to human subjects, frequent omission of extremely low frequencies which are regularly present in all telecommunication, as well as frequent use of only one toxic stimulus as a stressor, whereas in real-life settings humans are exposed to numerous stressors which can exacerbate the existing adverse effects of radiation. Simkó & Mattsson (2019: 16) also criticize the quality of some of the research: “[T]oo few studies fulfill the minimal quality criteria to allow any further conclusions.” Kostoff et al. (2020) conclude: “[A]lmost all of the wireless radiation laboratory experiments that have been performed to date are flawed/limited with respect to showing the full adverse impact of the wireless radiation that would be expected under real-life conditions.” What is more, “studies have shown that industry-funded research of wireless radiation adverse health effects is far more likely to show no effects than funding from non-industry sources [Huss et al. 2007; Slesin 2006; Carpenter 2019].” (Kostoff et al. 2020). It should, however, also be emphasized that technological innovations of 5G are expected to bring benefits for the public health as well, particularly in the domains of telemedicine and extremity rehabilitation (Li 2019; Li & Wang 2019).

Despite the lack of consensus, the use of 5G technology clearly poses a potential public health issue (cf. Bircher & Kuruville 2014; Mason et al. 2018). In this regard it has been recognized that media/journalists play a decisive role in how public health issues are perceived in the public, how the public will respond to the issue, and what the public knows about the issue (Leask et al. 2010; Wallington et al. 2010). Furthermore, media can act as catalysts to promote particular health practices in the public (Institute of Medicine 2003). However, there is an increasing amount of

misinformation on health topics in the media (Dhoju et al. 2019; Scheufele & Krause 2019), rendering the relationship between the media and public health complicated. We are not aware of any studies specifically investigating media misinformation on the health effects of 5G.

2. METHODOLOGY

2.1. Materials (corpora)

News articles for the experimental corpus were extracted from the Croatian news website Index.hr (<https://www.index.hr/>). This news website was chosen because the author of this paper had come across a news article from this website which contained suspicious information on the health effects of 5G. We extracted all news articles marked with “#5G” or “#5G mreža (‘5G network’)” from the website. We selected only those articles which addressed health effects of 5G. News articles written by the Croatian News Agency and published on Index.hr were not included in the experimental corpus. The search generated nine news articles altogether. Two of the nine articles were identical in content. Thus, one was excluded with the experimental corpus finally consisting of eight news articles. All articles were written by different authors. The oldest article was published on April 8, 2019 and the newest article was published on April 7, 2020.

We constructed two control corpora. The first control corpus consisted of eight randomly chosen news articles about the health effects of 5G published by “reliable” mainstream media (see Dhoju et al. 2019). The reliability of the medium was determined subjectively by the author. The media included news websites by BBC, Tagesschau, Spiegel Online, Hrvatska radiotelevizija, Zeit Online, Frankfurter Allgemeine Zeitung, and Süddeutsche Zeitung. All articles were published by different media. The oldest article was published on January 16, 2019 and the newest article on July 17, 2019. If there would be significant differences between the Index.hr 5G, and reliable 5G corpora, this would suggest that Index.hr unreliably reports on the health effects of 5G.

The second control corpus consisted of news articles from Index.hr which were about science, but not 5G. The second control corpus consisted of eight randomly chosen articles which were published in approximately the same time frame as their experimental counterparts. All articles in the second control corpus were written by different authors and none of the authors was the author of any of the news articles from the experimental corpus. The oldest article was published on June

4, 2019 and the newest on February 24, 2020. If there would be significant differences between the Index.hr 5G, and Index.hr science corpora, this would suggest that there is specific manipulation of information on the health effects of 5G.

All news articles were assessed by the author on the presence of references, presence of scientific references (clear information about and/or links to a scientific paper or a summary of a scientific paper), presence of clear misinformation (in the present study: erroneous referencing, and denial of the existence of scientific literature on a particular topic), expression of an opinion about the issue, and expression of a subjective opinion about the issue. In the present study opinions were identified as subjective if they were expressed with the use of subjective words (see Results), or if they were not backed by any type of external information.

We also assessed the number of hyperlinks in each article. According to Dhoju et al. (2019: 94) articles published by reliable media contain more hyperlinks compared to articles published by unreliable media. In their study reliable media had a median of eight hyperlinks per article, while most articles published by unreliable media had less than one or no hyperlinks. Hyperlinks referencing to articles published by the same medium were excluded from analyses. Furthermore, we assessed the number of visual media in each article. According to Dhoju et al. (2019: 95), no differences in the number of visual media per article between reliable and unreliable news media should be expected. In their study articles from reliable media had a mean of 13.83 visual media, while articles from unreliable media used 14.22 visual media on average.

2.2. Statistical analyses

Statistical analyses were conducted in JASP 0.11.1.0. The chi square test was used to compare categorical variables between groups. We report the Likelihood ratio because of the small sample size (< 30), along with Cramer's V for effect sizes. We also manually calculated the odds ratio. If a contingency table contained a count which was = 0, the Haldane-Anscombe correction was applied. The independent sample t-test, namely the Mann-Whitney U and Welch's tests, was used for the analysis of group differences in the number of hyperlinks and visual media. Rank-biserial correlation, and Cohen's d were reported for effect sizes, respectively. Normality of distribution was tested using the Shapiro-Wilk test of normality, and the Levene's test of equality of variances was used for the assumption of homogeneity of variance.

3. RESULTS

Group values of the categorical variables are shown in Table 1. References and scientific references were detected in all corpora. Articles with the author's opinion were found in the Index.hr 5G and reliable 5G corpora, but not in the Index.hr Science corpus. Articles with misinformation (Table 2), and articles with a subjective opinion by the author (Table 3) were identified only in the Index.hr 5G corpus. Regarding misinformation, two cases of erroneous referencing, and one case of denial of the existence of scientific literature on the health effects of 5G were detected. Additionally, all subjective opinions favored the hypothesis that 5G had no adverse health effects. Subjective words in the expression of subjective opinions included *sulud* 'silly', *naravno* 'naturally, of course', and *lud* 'crazy'. One Index.hr 5G article which had no references, no scientific references, and expressed a subjective opinion (but had no misinformation) was written by a doctor of psychology.

Table 1

Group values of the categorical variables

Group/Corpus	Articles with references	Articles with scientific references	Articles with misinformation	Articles with the author's opinion	Articles with a subjective opinion by the author
Index.hr 5G	5/8	1/8	3/8	8/8	4/8
Index.hr Science	8/8	3/8	0/8	0/8	0/8
Reliable 5G	7/8	6/8	0/8	3/8	0/8

Table 2

Cases of misinformation in the Index.hr 5G corpus

Subject/ Article no.	Original text in Croatian	Translation into English (by the author)
2	Naravno, ne postoje nikakvi znanstveni dokazi da peta generacija mobilne	There are, naturally, no scientific evidence that the fifth generation of mobile

	komunikacije, poznatija kao 5G, izaziva ili pogoršava novu bolest COVID-19 koju izaziva koronavirus SARS-CoV-2. Tom se temom, među ostalima, pozabavio i nezavisna britanska stranica za provjeru činjenica (fact check) Full Fact.	communication, better known as 5G, causes or worsens the new disease COVID-19 which is caused by the coronavirus SARS-CoV-2. This topic has been discussed, among others, by the independent British fact-checking website Full Fact.*
5	Hrvati se bune protiv 5G mreže. Ona je opasna po zdravlje kao sušena šunka	Croatians are protesting against the 5G network. It is as adverse to our health as is smoked ham**
6	Jasno, kako to često biva kod takvih stvari, priče o štetnosti 5G mreže su najobičnija nagađanja i nemaju uporišta u znanosti.	Of course, as it often is with these things, the stories about the adverse effects of 5G network are pure guessing, and they have no foundation in science.

Notes. The first two cases of misinformation were cases of erroneous referencing, while the third case was one of denial of the existence of scientific literature on health effects of 5G. * A closer inspection of the referenced hyperlink to the Full Fact article reveals that it doesn't fact-check whether 5G causes or worsens [the symptoms of] COVID-19, but whether it has adverse effects on the immune system which would make one more susceptible to viral, including coronaviral, infections. Additionally, there are at least several studies suggesting the possibility that exposure to man-made electromagnetic fields might lead to immunosuppression and thus increase the risk of opportunistic infections (see Doyon & Johansson 2017 and papers cited therein). ** This claim is based on the fact that the International Agency for Research on Cancer classified radio frequency exposure as possibly cancerogenic (International Agency for Research on Cancer 2013), and the "pseudofact" that smoked ham is also classified as possibly cancerogenic. Interestingly, this "pseudofact" is not expressed explicitly in the main text, but is implicitly expressed two times, once in the title, and once in a subheading. Firstly, smoked ham is not specifically identified as a (possibly) cancerogenic agent by the IARC. Secondly, processed, and red meat are not in the same category as radio frequency radiation. Thirdly, carcinogenesis is not the only possible adverse effect of radio frequency radiation.

Table 3

Cases of a subjective opinion by the author

Subject/ Article no.	Original text in Croatian	Translation into English (by the author)
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1	Iako se <u>suluda</u> teorija zavjere protiv 5G mreže proširila cijelim svijetom [...].	Although this <u>silly</u> conspiracy theory against the 5G network has dispersed all over the world [...].
2	<u>Naravno</u> , ne postoje nikakvi znanstveni dokazi da peta generacija mobilne komunikacije, poznatija kao 5G, izaziva ili pogoršava novu bolest COVID-19 [...].	There are, <u>naturally</u> , no scientific evidence that the fifth generation of mobile communication, better known as 5G, causes or worsens the new disease COVID-19 [...].
3	Subjective opinion not backed by any type of external information.	
4	Internetom kruže <u>lude</u> teorije da je 5G tehnologija uzrokovala koronavirus	<u>Crazy</u> theories about the 5G technology causing the coronavirus are circling the internet

Group values of hyperlink and visual media frequency are shown in Table 4. Hyperlinks and visual media were detected in all corpora. Articles without hyperlinks were found in all corpora. All articles in all corpora displayed at least one visual medium.

Table 4

Descriptive data on hyperlinks and visual media

Group/Corpus	Hyperlinks	Visual media
Index.hr 5G	1.750 (3.495)	2.750 (2.493)
Index.hr Science	1.000 (0.535)	1.125 (0.354)
Reliable 5G	2.375 (2.446)	2.500 (2.000)

Notes. The mean values are reported. Standard deviations appear in parentheses.

3.1. Index.hr 5G articles vs. reliable 5G articles

Categorical variables – Results of the chi square test are shown in Table 5. There were no significant differences in the number of articles with references between the Index.hr 5G and reliable 5G corpora, with a small effect size. Still, the odds ratio analysis showed that Index.hr 5G articles were 4.20 times likelier to contain no references than reliable 5G articles. There were significantly less articles which contained scientific references in the Index.hr 5G corpus compared to the reliable 5G corpus, with a large effect size. Additionally, Index.hr 5G articles were 21.02

times likelier to contain no scientific references compared to reliable 5G articles. The Index.hr 5G corpus also displayed significantly more articles which contained misinformation compared to the reliable 5G corpus, with a moderate effect size. Index.hr 5G articles were 10.78 time likelier to contain misinformation compared to reliable 5G articles. The Index.hr 5G corpus also contained significantly more articles in which the author gave his opinion on the issue, with a large effect size. Index.hr 5G articles were 26.73 times likelier to express the author’s opinion on the issue compared to reliable 5G articles. Furthermore, the Index.hr 5G corpus contained significantly more articles in which the author’s subjective opinion was expressed compared to the reliable 5G corpus, with a large effect size. Index.hr 5G articles were 16.95 more likely to include a subjective opinion on the issue compared to reliable 5G articles.

Table 5

Results of the chi square test comparing Index.hr 5G and reliable 5G articles

Variable	Chi square	Effect size
References	$X^2 = 1.381, p = .240$	$V = 0.289$
Scientific references*	$X^2 = 6.904, p = .009$	$V = 0.630$
Misinformation*	$X^2 = 4.857, p = .028$	$V = 0.480$
Author’s opinion*	$X^2 = 9.290, p = .002$	$V = 0.674$
Subjective opinion*	$X^2 = 6.904, p = .009$	$V = 0.577$

Notes. $df = 1, N = 16.$ * $p \leq .05.$

Hyperlinks – Because normality of distribution was violated in the Index.hr 5G group ($p < .001$), and the assumption of homogeneity of variance was not violated ($p = .787$), we compared the two values using the Mann-Whitney U test. The difference between the two groups in the number of hyperlinks per article was not significant ($U = 40.500, p = .369$), with a small effect size ($r = 0.266$).

Visual media – Normality of distribution was violated in both the Index.hr ($p = .012$) and the reliable 5G groups ($p = .021$). The assumption of homogeneity of variance was not violated ($p = .612$). Mann-Whitney U test revealed no significant differences between groups in the number of visual media per article ($U = 31.500, p = 1$), with a trivial effect size ($r = 0.016$).

3.2. Index.hr 5G articles vs. Index.hr science articles

Categorical variables – Results of the chi square test are shown in Table 6. There were significantly less articles with references in the Index.hr 5G corpus compared to the Index.hr science corpus, with a moderate effect size. The odds ratio analysis showed that Index.hr 5G articles were 10.78 times likelier to contain no references than Index.hr science articles. There were no differences between the two corpora in the number of articles with scientific references, with a small effect size. Still, Index.hr 5G articles were 4.20 times likelier to contain no scientific references compared to Index.hr science articles. The Index.hr 5G corpus also displayed significantly more articles which contained misinformation compared to the Index.hr science corpus, with a moderate effect size. Index.hr 5G articles were 10.78 times likelier to contain misinformation compared to Index.hr science articles. The Index.hr 5G corpus also contained significantly more articles in which the author gave his opinion on the issue compared to the Index.hr science corpus, with a large effect size. Index.hr 5G articles were 288.14 times likelier to express the author’s opinion on the issue compared to Index.hr science articles. Furthermore, the Index.hr 5G corpus contained significantly more articles in which the author’s subjective opinion was expressed compared to the Index.hr science corpus, with a large effect size. Index.hr 5G articles were 16.95 more likely to include a subjective opinion on the issue compared to Index.hr science articles.

Table 6

Results of the chi square test comparing Index.hr 5G and Index.hr science articles

Variable	Chi square	Effect size
References*	$X^2 = 4.857, p = .028$	$V = 0.480$
Scientific references	$X^2 = 1.381, p = .240$	$V = 0.289$
Misinformation*	$X^2 = 4.857, p = .028$	$V = 0.480$
Author’s opinion**	$X^2 = 9.290, p < .001$	$V = 1.000$
Subjective opinion*	$X^2 = 6.904, p = .009$	$V = 0.577$

Notes. $df = 1, N = 16$. * $p \leq .05$, ** $p \leq .001$.

Hyperlinks – Normality of distribution was violated in both the Index.hr 5G ($p < .001$), and the Index.hr science corpora ($p = .005$). Assumption of homogeneity of variance was violated as well ($p = .028$). Thus, we compared the two values using the Welch’s test. The difference between the

two groups in the number of hyperlinks per article was not significant [$t(7.327) = 0.600, p = .567$], with a small effect size ($d = 0.300$).

Visual media – Normality of distribution was violated in both the Index.hr 5G ($p = .012$), and the Index.hr science corpora ($p < .001$). The assumption of homogeneity of variance was also violated ($p = .004$). Welch's test revealed no significant differences between groups in the number of visual media per article [$t(7.281) = 1.825, p = .109$], but with a large effect size ($d = 0.913$). The absence of a significant difference with the simultaneous presence of a large effect size in the present case presumably indicates that the outcome would have been significant, if the number of data points were larger.

4. DISCUSSION

Comparisons of news articles about health effects of 5G published by Index.hr, and news articles about health effects of 5G published by reliable mainstream media revealed that the Index.hr 5G corpus contained significantly more articles with no scientific references, as well as significantly more articles with misinformation, expression of the author's opinion, and expression of a subjective opinion by the author compared to the reliable 5G corpus. Put in numbers, articles in the Index.hr 5G corpus compared to articles in the reliable 5G corpus were 21.02 times likelier to have no scientific references, were 10.78 times likelier to contain misinformation, were 26.73 times likelier to express the author's opinion, and were 16.95 times likelier to express a subjective opinion. No group differences emerged in the presence of references, but the odds ratio analysis still showed that articles in the Index.hr 5G corpus were 4.20 times likelier to contain no references compared to articles in the reliable 5G corpus. These results suggest that Index.hr is a significantly less reliable source of information on health effects of 5G compared to the present corpus of reliable media articles.

Comparisons of news articles about health effects of 5G published by Index.hr, and news articles about science (but not 5G) published by Index.hr revealed that the Index.hr 5G corpus contained significantly more articles with no references, as well as significantly more articles with misinformation, expression of the author's opinion, and expression of a subjective opinion by the author compared to the Index.hr science corpus. Put in numbers, articles in the Index.hr 5G corpus

compared to articles in the Index.hr science corpus were 10.78 times likelier to contain no references, were 10.78 times likelier to contain misinformation, were 288.14 times likelier to express the author's opinion, and were 16.95 times likelier to express a subjective opinion. No group differences emerged in the presence of scientific references, but the odds ratio analysis still showed that articles in the Index.hr 5G corpus were 4.20 times likelier to contain no scientific references compared to articles in the Index.hr science corpus. However, the fact that there were significant differences in the presence of scientific references between the Index.hr 5G, and reliable 5G corpora, but not between the Index.hr 5G, and the Index.hr science corpora, possibly suggests that Index.hr relies less on scientific references in general.

These significant differences between the two Index.hr corpora demonstrate that there are qualitative differences within Index.hr in the production of news articles on health effects of 5G compared to the production of other scientific news articles. Compared to the production of general news articles on science, the production of news articles on health effects of 5G is thus characterized by a reduction in referencing, and an increase in misinformation, opinion expression, and opinion subjectivity. The simultaneous increase in misinformation and reduction in referencing suggests that misinformation doesn't stem from other unreliable sources of information, but that the misinformation is produced within Index.hr. An increase in opinion expression, and opinion subjectivity in the context of misinformation suggests that Index.hr is manipulating the information on health effects of 5G. This is corroborated by the fact that the two types of misinformation identified in the present study included erroneous referencing, and denial of the existence of scientific literature on the topic. Furthermore, all articles on both 5G, and scientific topics were written by different authors, indicating that this phenomenon is systematic within Index.hr. Although the present data point to manipulation of information on the health effects of 5G, caution should be warranted due to the small sample size. However, we extracted all articles on health effects of 5G from Index.hr, making this issue insurmountable at the moment.

We found no significant differences in the raw number of hyperlinks, and visual media between all three corpora. However, the effect size for the difference in the number of visual media between the Index.hr 5G, and Index.hr science corpora was large, suggesting that if the sample were larger, the Index.hr 5G articles would have presumably contained significantly more visual media compared to Index.hr science articles. It is difficult to interpret this result at the moment. Our mean

raw values of hyperlinks and visual media greatly differed from Dhoju et al. (2019). They reported a median of eight hyperlinks for reliable media, while the reliable 5G corpus in the present study had a mean of 2.375 hyperlinks (and a median of 2; not reported in the results section). Furthermore, articles across corpora in our study contained on average between 1.125 and 2.750 visual media, while in the mentioned study articles from both reliable, and unreliable media contained on average around 14 visual media. We suggest that the raw number of hyperlinks may not be a valid measure for media reliability. Additionally, our results are in line with Dhoju et al. (2019) who found no differences between reliable, and unreliable media in the number of visual media per article.

5. LIMITATIONS

Firstly, the sample size is small, as discussed in different parts of the paper. Secondly, the reliability of media for the reliable 5G corpus was assessed subjectively by the author. Thirdly, the assessment procedure was not based on previously published literature. Finally, this study used a very narrow methodological frame. Nevertheless, we find it, in this case at least, effective.

6. CONCLUSION

The present case study investigated whether the Croatian news website Index.hr manipulates information on the health effects of 5G. We constructed one experimental corpus, containing all articles by Index.hr on health effects of 5G, and two control corpora, one with articles about health effects of 5G published by reliable media, and one with articles about science (but not 5G) published by Index.hr. We assessed the presence of references, scientific references, misinformation, opinion expression, and opinion subjectivity. Compared to Index.hr science articles, Index.hr 5G articles were 10.78 times likelier to contain no references, 4.20 times likelier to contain no scientific references, 10.78 times likelier to contain misinformation, 288.14 times likelier to express the author's opinion, and 16.95 times likelier to express a subjective opinion. The simultaneous increase in misinformation and reduction in referencing suggests that misinformation doesn't stem from other unreliable sources of information, but that the misinformation is produced within Index.hr. An increase in opinion expression, and opinion

subjectivity in the context of misinformation suggests that Index.hr is manipulating the information on health effects of 5G. This is corroborated by the fact that the two types of misinformation identified in the present study included erroneous referencing, and denial of the existence of scientific literature on the topic. Furthermore, all articles on both 5G, and scientific topics were written by different authors, indicating that this phenomenon is systematic within Index.hr. We conclude that our data point to a manipulation of information on health effects of 5G by Index.hr. Still, the small sample size warrants a degree of caution.

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