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Measuring alleged protective effect of Vivobase Home device on human organism during the exposure to Wi-Fi microwave radiation**

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Abstract

The company Vivobase GmbH requested scientific validation of their product Vivobase Home, which allegedly protects the user from Wi-Fi microwave radiation. Validation was done via testing on human organisms following clinical research conditions. In the testing, we exposed volunteers to Wi-Fi radiation while volunteers were near the Vivobase Home device switched on or off (control).

The testing shows high overall statistical differences (meaning differences in p-value and Cohen's D) between the two testing situations (the device on or off), where in both cases, the testees were exposed to the same procedure and the same dose of Wi-Fi microwave radiation during the whole time of testing. Since the testing shows significant differences in the allegedly protected and unprotected situations, we conclude that the device has an impact on the human organism, which compensates for the Wi-Fi microwave radiation bioeffects, at least to some extent.

Keywords

Vivobase Home, physiological testing, physiological parameters, human organism, protective effect, Wi-Fi microwave radiation, clinical research conditions

** Peer reviewed article (see the reviewer's conclusion in Appendix; the whole review is archived at the BION Institute).

CONTENTS

1 INTRODUCTION

1.1 General

A fundamental research area at the BION Institute represents measuring the effects/influences of physically as yet undefined and unrecognized (subtle) field(s) or weak conventional fields in the resonant mode (Kernbach et al., 2013; Jerman 2021). Generally, ordinary measuring devices are not adapted to measure these fields. However, most frequently, even various unconventional devices, purportedly measuring the subtle field effects, are not yet capable of measuring this kind of field (influences) reliably enough, although the technology is steadily improving. For the most part, these fields and their effects cannot be explained by commonly accepted theoretical interpretations, even though some scientists have offered possible explanations ranging from the quantum vacuum and coherent fields to dark matter (see Kernbach 2022; Meijer et al., 2021; Jerman et al., 2009).
In more than 20 years of experimenting with various detector systems for subtle field's testing, including also electrophotography and plant germination (Berden et al.,1997; Ružič, Jerman 2002), the BION Institute developed an alternative path that makes it possible to use the *human organism* as a reliable detector of such weak or subtle influences (Jerman, Dovč, 2017). We learned how to express these detections via easily measurable general physiological effects monitored through physiological measurements (Jerman et al., 2019a, 2019b). During the development of the test system, which is based on the measurement of human physiological parameters, we tested various parameters, including HRV, skin electrical conductivity variability (VSC), and EEG. As HRV and VSC did not give us any added value, they were abandoned. However, we use EEG when testing effects primarily related to the head (as shown in the previously quoted articles) or at a specific request of the client. After all this experimentation and experiences, we can reasonably assess an alleged biological influence or non-influence emanating from devices based on weak (subtle) impact. The latter may represent a stimulating factor or a protective shield against allegedly harmful environmental radiation.

1.2 Specific

1.2.1 The object of testing

The company Vivobase GmbH requested testing of an alleged protective influence on the human organism against wireless router (from now on Wi-Fi router) radiation for the product Vivobase Home (Figure 1). Namely, according to some research, microwave irradiation emanating from various sources like mobile phones or Wi-Fi router have damaging effects, at least on mitochondrial function (see Hao et al., 2015). The customer claims that the named product has a protective influence against Wi-Fi router radiation and wanted these claims to be validated. With a methodology grounded on clinical research conditions (see Portney, 2020; Lewith et al., 2010), we tested the alleged protective influence of the Vivobase Home by exposing volunteer test persons (from now on testees or test subjects) to Wi-Fi microwave radiation while they were near the

Vivobase device. Several physiological parameters (see Chapter 2.5) were monitored by the appropriate measurement protocol (Giannakakis G. et al., 2022).
In the testing, the question of the possible technical (physical) protecting capacity of the device was not tackled. The testing was concentrated only on the products' alleged influence on the human organism so that the latter gains measurable support to physiologically combat the microwave radiation burden emanating from a Wi-Fi router.

1.2.2 Basic hypothesis

The general working hypothesis of the research is based on the view that if there is a shielding effect of the devices, the shielding situation should give a similar physiological response of the body as a control situation not burdened by microwave radiation. A protective effect can therefore be stated if the protective situation and the control situation have a similar physiological response, while to microwave radiation exposed situation shows a different effect, possibly also statistically significantly different from the first two.

2 MATERIALS AND METHODS

2.1 Objects (devices, products) subject to testing

Vivobase Home (Figure 1) produced by company Vivobase GmbH.

Figure 1: Vivobase Home device subject to testing.

2.2 Testing principles

The manufacturer's claims are validated by testing based on clinical research principles. This means that the tests are:

- *prospective* (general criteria for the efficiency of the product's influence are determined in advance);
- *with placebo effect ruled out* (testees don't know whether they are exposed to the product's influence or not);
- *double-blind* (even the test assistant doesn't know whether it is about the exposed situation or the control one);
- *randomized* (the decisions about the order of different situations are made randomly).

2.3 Situations investigated in testing

The alleged protective influence of the Vivobase Home product on the human organism was tested by measuring the physiological parameters of testees exposed to Wi-Fi router radiation (see Figures 2-4). In order to determine whether there is any protective effect of the supposedly protective product, testees were assigned to *three different experimental situations,* in a random order for a testee:

- exposure to the Wi-Fi router radiation plus working Vivobase Home: subject to a presumed protective influence of the named product (Wi-Fi&Vivobase Home situation),
- exposure solely to the Wi-Fi router radiation: detecting the influence of Wi-Fi radiation (Wi-Fi situation),
- no exposure: detecting the influence of background radiation with no active Wi-Fi router in the vicinity and with no active Vivobase Home (Control situation).

Figure 2: Demonstration of an actual testing situation. Both devices are covered by a cardboard box so that neither the assistant nor the test taker can know which situation is being performed. In addition, the test subjects do not know what is under the box.

Figure 3: Demonstration of the test session with uncovered Wi-Fi router and the Vivobase Home device. As seen in Figure, both are connected to electricity. The Wi-Fi router is connected to the internet. The activation of both is monitored by

a second assistant from the adjacent room, so the test subjects and the first test assistant cannot know which situation is tested, thus ensuring double-blind testing.

Figure 4: Demonstration of the test session during testing with uncovered WI-Fi router and the Vivobase Home device. The Wi-Fi router is placed 1 m away, and the Vivobase Home device is 5 m away from the testee, in line with the Wi-Fi router and the testee. After all the sensors were placed on the testee, he/she sat for 35 minutes while physiological parameters were measured.

2.4 Testing implementation and protocol

Tests were conducted from August 8 to September 5, 2022, at the BION Institute with 30 testees aged 19 to 74 (twenty females and ten males). They were subjected to all three situations. Before the tests, the testees were instructed not to eat a big meal at least one hour before the test and not to drink coffee, alcohol, or energy drinks at least three hours before the test. The physiological parameters of each person were measured three times on three different days, every time at the same time of the day. This ruled out the effects of other factors as much as possible (e.g., the testee could be tired after many hours of work but should be more or less at the same level of fatigue at the same time of day). Random order of both situations was applied to each testee (the principle of randomization). Testees sat for 35 minutes in a comfortable wooden chair. During this time, physiological parameters were measured, as presented in Figure 2. An 8-channel Biosignalsplux device was used to measure the aforementioned physiological parameters. The Wi-Fi router was placed 1 m and the Vivobase Home device 5 m away from the testee. Vivobase Home device was in line with the Wi-Fi router and testee (Figures 2 and 4). The distance was calculated from the maximum range specified by the manufacturer (30 m)

and assessment of the average distance of a wireless router (6 m at home and 12 m at work). The distance (Figure 4) was assessed from an expected average in real-life situations. An inverse-square law (power decrease) is supposed for both devices (Wi-Fi router and Vivobase Home). Both devices were hidden in a cardboard box (see Figure 2), so the testees didn't know what was the object of testing. As seen in Figures 2-4, both were connected to electricity. The Wi-Fi router was connected to the internet. The activation of both was monitored by a second assistant from the adjacent room, so the testee and the first test assistant cannot know which situation is tested, thus ensuring double-blind testing.

Then the physiological measurements started. The first test assistant left the testees alone in the room. After 5 minutes, the second assistant played a video stream on a laptop in the next room that was connected to a Wi-Fi router in the testing room. The video stream wasn't played in the *Control situation* since the Wi-Fi router was turned OFF. The vast majority of the testees have long-term testing experiences involving various devices and tend to be quite indifferent regarding various testing situations and the object of testing.

2.5 Physiological parameters

Measurements of physiological parameters by an appropriate device make it possible to monitor dynamic responses to any agent allegedly influencing the human organism in real time. By default, the following parameters were measured:

Heart rate (frequency of heartbeat, HR) is calculated from the electrocardiogram (ECG). Differences in heart rate speak about activities of the autonomous nervous system on its deep level in its two parts (sympathetic and parasympathetic).

Muscle tension (electromyogram, EMG) is measured on the right forearm. This parameter gives information about the state of the somatic system in terms of tension or relaxation. Besides muscle tension, the EMG shows any artifacts that could appear on the ECG due to arm movements.

Skin conductance (SC) is measured on the fingertips of the right hand, where it varies the most. Skin conductance measurements are part of lie detectors because both, sweating and blood flow affect it. Consequently, it is regulated by the sympathetic nervous system (see also Cowley et al., 2016; Boucsein, 2012). The latter is a part of the autonomous nervous system that is not under our conscious control, so we cannot regulate it just by simple intention. In general, skin conductance is higher when a person is under stress (more sweating, faster interior blood flow), but sometimes the response may be much more complex.

Respiration rate (RR) is calculated from thorax expansion (TE), where the latter is measured with a special extendable elastic belt. Similar to the heart rate, the respiration rate also speaks about the activities of the autonomous nervous system, only that it is under the possible partial influence of our consciousness.

Finger temperature (TEMP) is measured on the tip of the right-hand ring finger. The interpretation of differences in this parameter depends on the differences in skin conductance and demands thorough consideration. In ordinary cases, a higher peripheral temperature would mean a deeper relaxation.

2.6 Data processing

2.6.1 Capture and primary data analysis

After the measurement phase of the testing was over, the primary analysis of the data was performed. The two largest outliers were removed so that the presented analysis of data and the outcome are based on 28 testees. The raw data procedure was as follows. The data with a sampling frequency of 1000 samples per second were imported into *Matlab.* Within *Matlab* the electrocardiogram (ECG) data were analyzed with the Pan-Tompkins algorithm (see Pan, Tompkins, 1985) from which the inter-beat interval (IBI) data was obtained. Heart rate was derived from IBI data. Analysis of the thorax expansion data gave us the respiration rate (RR). All data were then resampled to one-second intervals by averaging the inter-second data points.
The first five minutes of the measurements were cut since they correspond to the time needed for the testee to calm down at the beginning of the measurements. Next, a geometric median of all testees was calculated for each measured physiological parameter. Two-time groups (marked as **Parts A** and **Part B**), each one 15 minutes in length, were selected. Geometric medians were then resampled so that each 15 min time window got represented in 15 steps. Afterward, the results were renormalized to an average of the first five minutes. This means the whole session was divided into two parts (A and B) and statistically evaluated for every parameter and each part separately.

2.6.2 Statistical analysis and evaluation

To check for the difference between all three test situations, the Friedman test was used to detect differences in treatments across multiple test attempts. Levene's test was used for equality of variances to check if there were any significant differences in data variability among all three situations. To check for the difference between both test situations, the Wilcoxon signed-rank paired test was used. The results of all statistical tests were corrected with the Holm-Bonferroni correction for multiple comparisons[1]. The results are estimated as significant if the p-value after the correction is below 0.05. If the p-value is between 0.05 and 0.1 and the absolute value of Cohen's D is above 0.5, then the result is considered to be significant as well. To decide if the influence of the tested device has an impact on human physiology in the presence of microwave radiation from a Wi-Fi router, the outcome of the testing should have at least two statistically significant differences between the control and the protected (Wi-Fi&Vivobase Home) situation *on one side* and the unprotected (Wi-Fi) situation on the other side (after Holm-Bonferroni correction) in Parts A and B.

[1] Holm-Bonferroni correction is a method used to adjust the p-values of statistical tests in order to control the familywise error rate (FWER), which is the probability of making at least one false discovery (also known as a type I error) among all the statistical tests performed. This correction is used when multiple statistical tests are performed simultaneously on the same data set – a in our case, and the risk of making a false discovery increases as the number of tests increases.

3 RESULTS WITH DISCUSSION

3.1 Overall statistical differences in physiological parameters

An overview of the Friedman test results demonstrates that there are statistically significant differences between the three experimental situations for all measured parameters in Part B (Table 1a), with high statistical differences for muscle tension (EMG) and skin conductance (SC). The Levene test (Table 1b) shows significant differences in variability for the skin conductance (SC) in Part A and respiration rate (RR) in both parts. Additional comparisons between different combinations of situations were made in the post hoc tests (Wilcoxon signed-rank paired test), which revealed statistically significant and highly significant differences between medians mostly in Part B in *Wi-Fi vs. Control* and *Wi-Fi vs. Wi-fi&Vivobase Home* comparisons (see Table 2).

Table 1a: Summary of the Friedman test corrected with Holm-Bonferroni correction for multiple comparisons (p-values). Values written in grey represent statistically insignificant differences between two experimental situations ($p > 0.05$), values written in magenta denote a trend, and values written normally represent statistically significant differences between at least two of the three different experimental situations ($0.001 < p < 0.05$), and the values written in bold a highly significant statistical difference ($p < 0.001$). **Marks**: HR – heart rate, EMG – muscle tension, SC – skin conductance, RR – respiration rate, and TEMP – finger temperature.

	HR	EMG	SC	RR	TEMP
Part A	0.688	0.075	0.688	0.339	0.339
Part B	0.014	**0.000**	**0.000**	0.003	0.004

Table 1b: Levene test with Holm-Bonferroni correction. Marks are the same as in Table 1a.

	HR	EMG	SC	RR	TEMP
Part A	0.144	0.565	0.012	0.020	0.600
Part B	0.238	0.354	0.600	0.008	0.142

The above table reveals that there was not a lot of variation between situations in either parameter, except for respiration rate. In the latter case, a closer examination of the results (standard errors, not presented here) shows that *Control* and *Wi-fi&Vivobase Home* are of the same level of variation and that the significant difference comes from the *Wi-Fi* situation, where the variability is much higher. It conforms to the basic hypothesis that the *Control* and *Wi-fi&Vivobase Home* situations should be at approximately the same level, while the *Wi-Fi* should diverge from both.

Table 2: Summary of Wilcoxon signed-rank post hoc test corrected with Holm-Bonferroni correction for multiple comparisons. Values written in grey represent statistically insignificant differences between the two experiment situations ($p > 0.05$), and values written normally represent statistically significant differences between the two compared experiment situations ($0.001 < p < 0.05$ or $0.05 < p < 0.1$

with absolute Cohen's D above 0.5), and the values written in bold a highly significant statistical difference ($p < 0.001$). **Marks**: HR – heart rate, EMG – muscle tension, SC – skin conductance, RR – respiration rate, and TEMP – finger temperature.

Comparison	Time	HR	EMG	SC	RR	TEMP
Control vs. Wi-Fi	Part A	0.688	0.020	0.165	0.018	0.909
	Part B	0.934	**0.001**	**0.001**	0.027	**0.001**
Wi-Fi&Vivobase Home vs. Wi-Fi	Part A	0.661	0.831	0.831	0.016	0.062
	Part B	0.008	0.062	**0.001**	**0.001**	0.007
Wi-Fi&Vivobase Home vs. Control	Part A	1.000	0.075	0.812	1.000	0.446
	Part B	0.020	0.172	1.000	1.000	1.000

3.2 More detailed results per parameters

In the following, boxplot graphs are presented for each measured parameter belonging to all three situations and two measurement parts. The line inside the boxplot represents the median of normalized (to the first five minutes) average values so that all parameters may be directly compared.

In Figure 5, showing the normalized heart rate, the *Wi-Fi&Vivobase Home* situation shows a highly significant difference compared to the *Wi-Fi* and *Control* situation in Part B. The result indicates that the Vivobase Home device had an invigorating effect on the vegetative system. Since there are no significant differences between *Wi-Fi* and *Control* situations, we could conclude that the Vivobase Home device has its own bioeffect on the heart rate (HR) parameter.

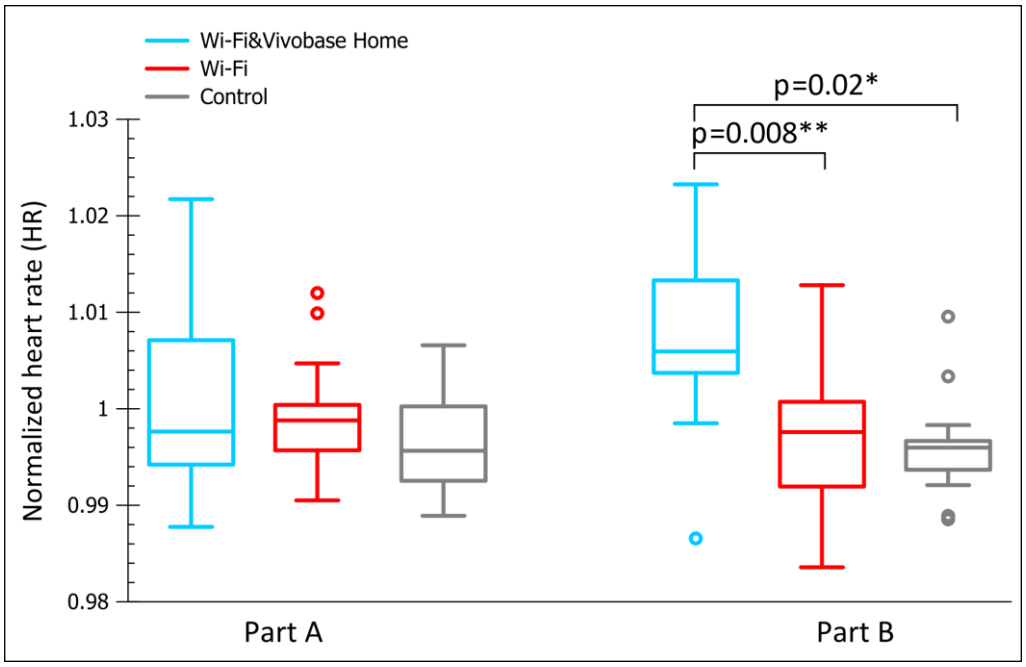

Figure 5: Normalized heart rate (HR) from the testees during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 28 testees. The single asterisk (*) marks a statistically significant difference between the two compared situations with $p < 0.05$. The

double asterisk (**) marks a high statistically significant difference between the two situations with $p < 0.01$.

Muscle tension (EMG, Figure 6) shows that in Part A, the *Wi-Fi&Vivobase Home* situation doesn't yet display a protective effect. However, in Part B, *the Wi-Fi&Vivobase Home* situation has a comparable value to the *Control* situation, which indicates its protective effect. *The Wi-Fi* situation has an invigorating effect, while the *Control* and the *Wi-Fi&Vivobase Home* situation remained approximately at the same level as in the beginning.

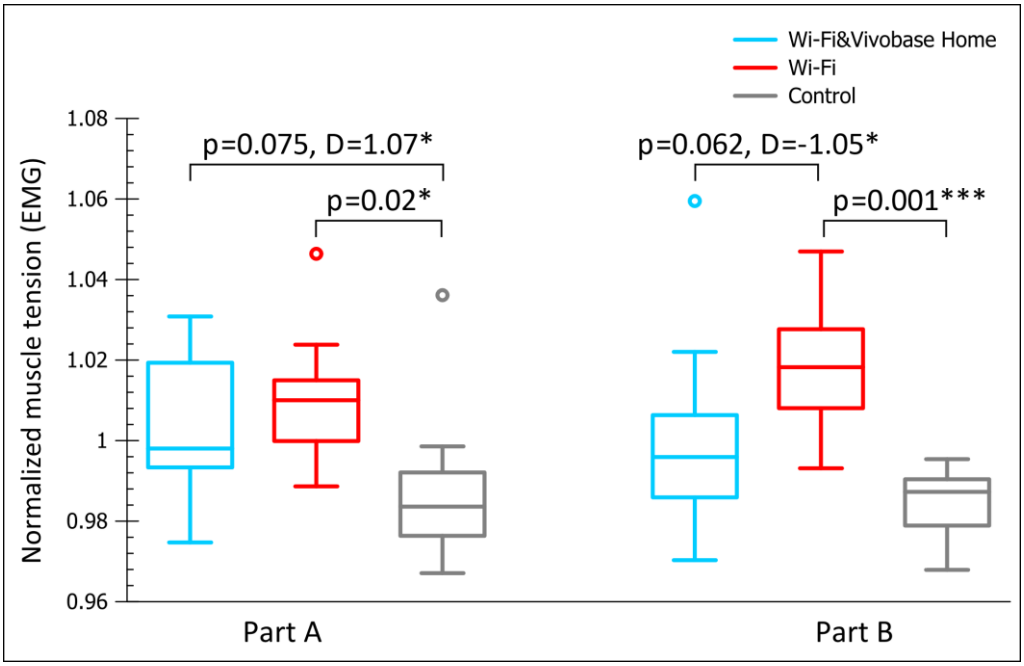

Figure 6: Normalized muscle tension (EMG) from the testees during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 28 testees. The single asterisk (*) marks a statistically significant difference between the two situations with $p < 0.05$, or $p < 0.1$ with absolute Cohen's D above 0.5. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

In Part B, for the skin conductance (SC), we can see a noticeable protective effect of the Vivobase Home device (Figure 7). The *Wi-Fi* situation has a relaxing effect; however, the *Wi-Fi&Vivobase Home* situation had a similar effect as the Control situation.
In Figure 8, for the respiration rate (RR), a protective effect of the *Wi-Fi&Vivobase Home* situation can be observed in both parts. Wi-Fi router has an invigorating effect on the vegetative system; nevertheless, the *Wi-Fi&Vivobase Home* situation resets it on the level of *Control* in a highly statistically significant manner.

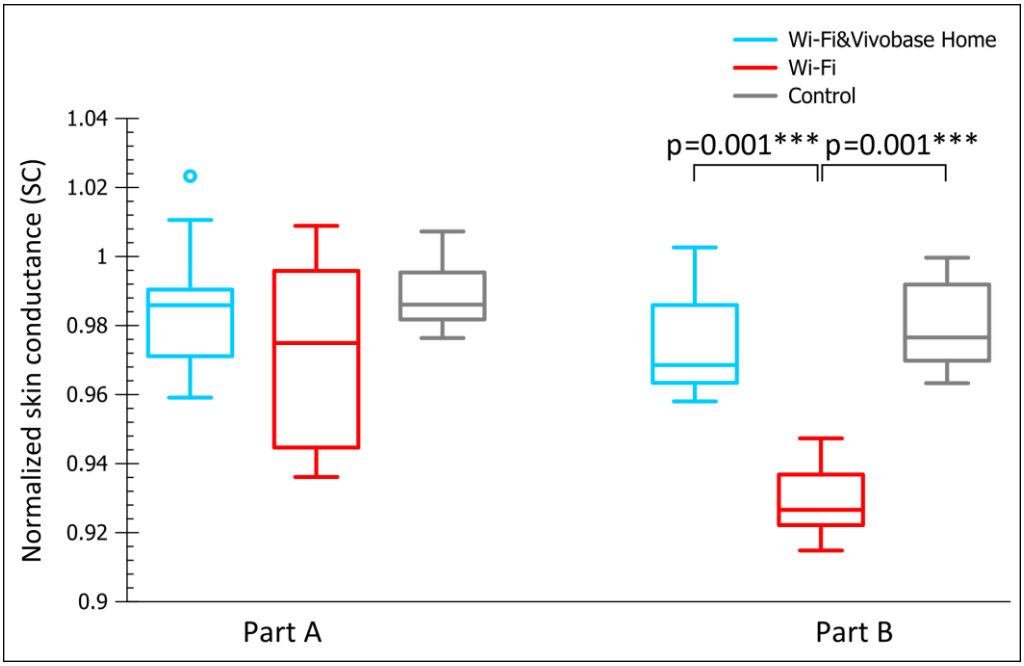

Figure 7: Normalized skin conductance (SC) from the testees during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 28 testees. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

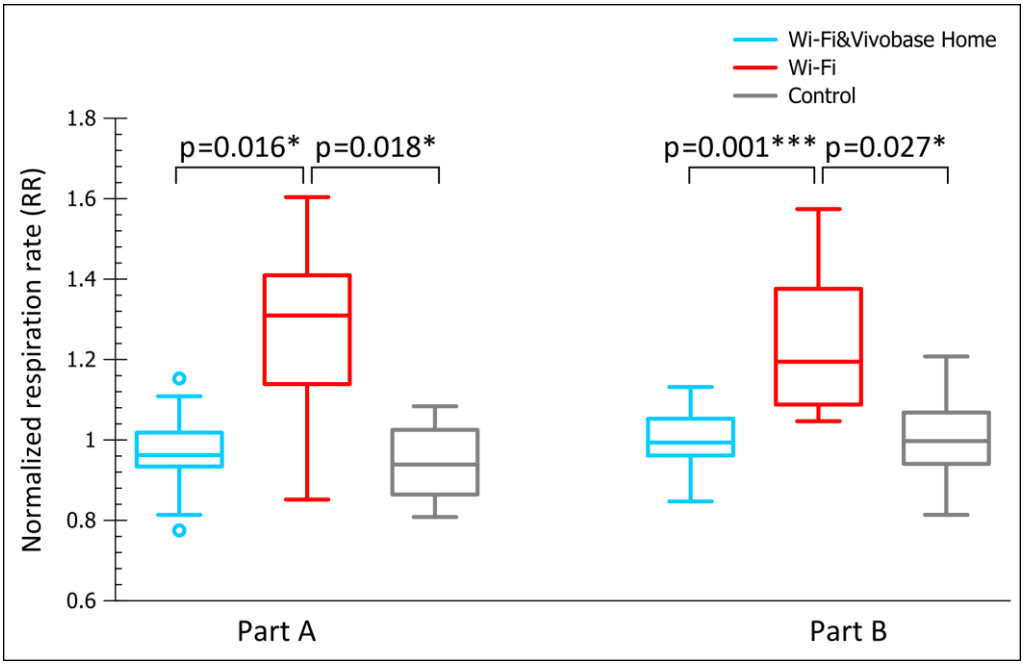

Figure 8: Normalized respiration rate (RR) from the testees during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 28 testees. The single asterisk (*) marks a statistically significant difference between the two situations with $p < 0.05$. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

Finger temperature (TEMP) in Figure 9 and Part A shows a statistically significant difference between the *Wi-Fi&Vivobase Home* situation and the *Wi-Fi* situation. Part B

displays an appreciable protective effect since the *Wi-Fi&Vivobase Home* situation is similar to the *Control* situation (no Wi-Fi exposure), and both are statistically significantly different from the *Wi-Fi situation*.

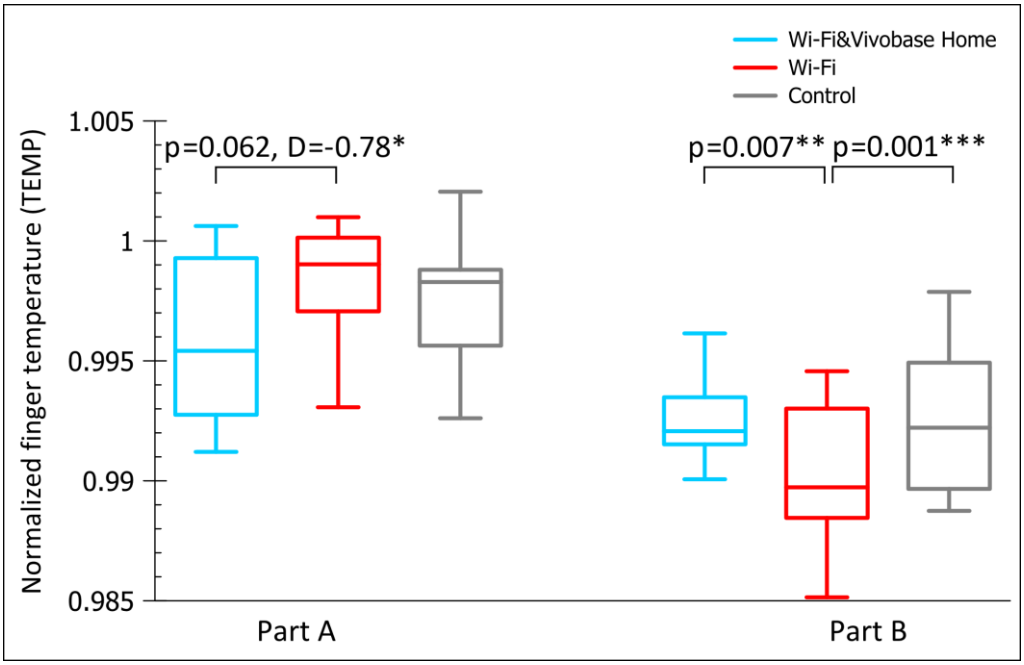

Figure 9: Normalized finger temperature (TEMP) from the testees during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 28 testees. The single asterisk (*) marks a statistically significant difference between the two situations with $p < 0.05$, or $p < 0.1$ with absolute Cohen's D above 0.5. The double asterisk (**) marks a high statistically significant difference between the two situations with $p < 0.01$. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

3.3 Standardized effective size

Besides statistical differences, the standardized effect size (Cohen's D) was also calculated. It demonstrates the magnitude and the sign (direction) of the tested protective influence. To show the standardized effect size, colour coding for the intensity and the direction of the impact is used. The values are presented in Table 3 below. The latter shows an overview of the effect size for the measured physiological parameters in the two measuring parts.

From Table 3, we may infer that in harmony with the working hypothesis, *Control* and *Wi-Fi&Vivobase Home* situations are similar to each other in terms of the Wi-Fi exposure situation (compare the first row with the third and the second with the fourth). Except for HR, we observe the same color (direction of the effect) and often the same shade. The overall result (also supported by variance in RR, see Table 1b and explanation below) convincingly speaks in favor of the protective effect of the Vivobase Home device. And from Table 3, we may also deduce that this protective effect means a relaxing influence on EMG and RR (see the blue coloring) and an invigorating influence on the SC parameter (red color).

Table 3: Cohen's D effect size for the measured physiological parameters. Negative values (blue colour) signify that the first situation decreased the parameter compared to the second situation, while the positive values (red colour) signify an increase of the parameter. Values with an underlined black font designate results where a statistically significant difference ($p < 0.05$, or $0.05 < p < 0.1$ with absolute Cohen's D above 0.5) between the two tested situations was assessed. Other values are not statistically significant, at least after the Holm-Bonferroni correction. The intensity of the background colour signifies the difference magnitude (an absolute value less than 0.2 indicates a *small difference*, an absolute value between 0.2 and 0.8 indicates a *medium difference*, an absolute value between 0.8 and 2 indicates a *large difference,* and an absolute value above 2 indicates a *huge difference*). **Marks**: HR – heart rate, EMG – muscle tension, SC – skin conductance, RR – respiration rate, and TEMP – finger temperature.

Comparison	Time	HR	EMG	SC	RR	TEMP
Control vs. Wi-Fi	Part A	-0.47	-1.59	0.80	-1.84	-0.27
	Part B	-0.07	-2.82	4.40	-1.59	0.75
Wi-Fi&Vivobase Home vs. Wi-Fi	Part A	0.19	-0.42	0.52	-1.65	-0.78
	Part B	1.32	-1.05	3.62	-1.86	0.93
Wi-Fi&Vivobase Home vs. Control	Part A	0.53	1.07	-0.30	0.31	-0.51
	Part B	1.54	0.87	-0.45	-0.22	0.00

4 CONCLUSION

Testing the effect of the product Vivobase Home on the human organism when exposed to Wi-Fi router microwave radiation validates the assumed protective influence and corroborated the working hypothesis. It is substantiated by:

a) high overall statistical differences between the two testing situations *Wi-Fi&Vivobase Home* vs. *Wi-Fi* (see Table 2), wherein in both cases, the testees were exposed to the same procedure and the same dose of Wi-Fi router microwave radiation.

b) the overall similarity of differences between the *Control* situation against Wi-Fi exposure and the *Wi-Fi&Vivobase Home* situation against Wi-Fi exposure (see Table 3, first four rows and the discussion below). The similarity means that the *Wi-Fi&Vivobase Home* situation (therefore Vivobase Home influence under relatively intensive router Wi-Fi irradiation) yielded very similar results to the control situation that was not subject to such radiation. It is persuasively demonstrated by three parameters: EMG, SC, and RR, and in a minor measure by temperature.

In addition to Table 3, the protective effect can also be seen in Figures 6-8. Here (most prominently in Figure 8), we can clearly see that the supposedly shielded situation with Wi-Fi on (in blue) has a similar value to the control situation (unshielded, but also without special Wi-Fi emission, grey). However, the unshielded situation and the situation with Wi-Fi radiation exposure (in red) are significantly different from both.

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6 APPENDIX

Concluding comments from the evaluator

On 14 December 2022, I reviewed two papers scheduled for publication on Research Gate: "Measuring alleged protective effect of Vivobase Home on human organism during the exposure to Wi-Fi microwave radiation"[2] and "Validating alleged protective effect of Vivobase Mobile and Vivobase Car products on human organism during the exposure to mobile phone microwave radiation" written by Igor Jerman, Jonatan Pihir, Mateja Senica, and Vesna Periček Krapež; BION Institute, Ljubljana, Slovenia, EU.

At the start of January 2023, the authors responded to my remarks and made the appropriate corrections, modifications, and adjustments. After these changes, I consider the text ready for publication.

[2] This part refers to this report.

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