Validating alleged protective effect of Vivobase Mobile and Vivobase Car devices on human organism during the exposure to mobile phone microwave radiation

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4 authors:

Igor Jerman

Jonatan Pihir

Mateja Senica

Vesna Periček Krapež

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Validating alleged protective effect of Vivobase Mobile and Vivobase Car devices on human organism during the exposure to mobile phone microwave radiation**

Igor Jerman*, Jonatan Pihir*, Mateja Senica*, Vesna Periček Krapež*

* Physiological Testing Department; BION, Institute for Bioelectromagnetics and New Biology, Ljubljana, Slovenia

Abstract:
The company Vivobase GmbH requested scientific validation of their devices Vivobase Car and Vivobase Mobile, which allegedly protect the user from microwave mobile phone radiation. Validation was done via testing on human organisms following clinical research conditions. Two tests were performed, one with the Vivobase Car and the other with the Vivobase Mobile. In the testing, volunteers were exposed to mobile phone radiation while sitting near one or the other device. The latter were 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 for each device (the device on or off), where in both cases, the testees were exposed to the same procedure and the same dose of mobile phone microwave radiation during the whole time of testing. Since both tests show similar and significant differences in the allegedly protected and unprotected situations, we conclude both devices have an impact on the human organism, which compensates for the mobile phone microwave radiation bioeffects, at least to some extent.

Keywords
Vivobase Mobile, Vivobase Car, physiological testing, physiological parameters, human organism, protective effect, mobile phone 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). Hence, 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 the testing of an alleged protective influence on human organisms against different types of non-ionizing radiation for the devices Vivobase Car and Vivobase Mobile (Figure 1). Namely, according to some research, microwave irradiation originating from various sources like mobile phones or Wi-Fi routers may have damaging effects, at least on mitochondrial function (see Hao et al., 2015). The customer claims that the named devices have a protective influence against mobile phone radiation and wanted these claims to be validated. With a methodology grounded on clinical research conditions (see Portney, 2020; Lewith et al., 2010), the alleged protective effect against mobile phone radiation was tested by exposing volunteer test persons (from now on testees) to its influence while they were near one or the other Vivobase device. Several physiological parameters (see Chapter 2.5) were monitored by the appropriate measurement protocol (Giannakakis et al., 2022).

In the testing, we did not tackle the question of the possible technical (physical) protecting capacity of the tested devices. The testing was concentrated only on the devices' alleged influence on the human organism so that the latter gains measurable support to physiologically combat the microwave radiation burden emanating from the mobile phone. To better discern possible impacts of devices, during the tests, a blind phase (calling phase, also named Part B) was introduced where the testee was exposed to a higher level of radiation.

1.2.2 Basic hypothesis

The general working hypothesis of the research follows the reasoning that if there is a protective influence of devices, there should be a sufficient level of statistically significant differences between the situation where the testees are exposed to the emanation of the device (switched on) and the situation, where they are not (the device switched off, the control situation). In both cases, testees are exposed to the same procedures and two different levels of microwave radiation from the mobile phone (standby phase, calling phase; see below for more details).

2 MATERIALS AND METHODS

2.1 Objects (devices, products) subject to testing

Vivobase Mobile (Figure 1A) and Vivobase Car (Figure 1B) produced by the company Vivobase GmbH.

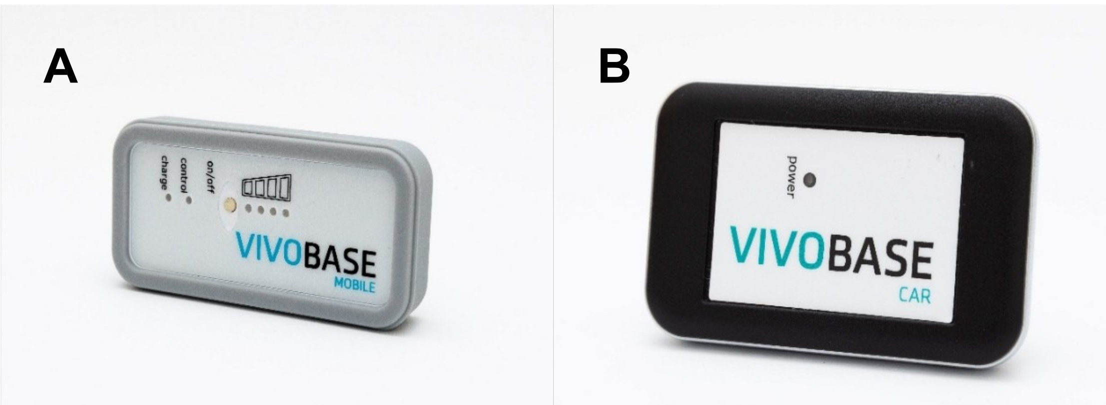

Figure 1: Vivobase Mobile (A) and Vivobase Car (B) devices used in testing.

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 device's influence are determined in advance);
- *with placebo effect ruled out* (testees don't know whether they are exposed to the device'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 named devices on the human organism was tested by measuring the physiological parameters of testees exposed to mobile phone microwave radiation. In order to determine whether there is any protective effect of both assumingly protecting devices and to know a possible difference between them, the testees were assigned to *three different experimental situations,* in a random order for a testee:

- exposure to mobile phone radiation plus working Vivobase Mobile: subject to a presumed protective influence of the named device (*Vivobase Mobile situation*, Figure 2),
- exposure to mobile phone radiation plus working Vivobase Car: subject to a presumed protective influence of the named device (*Vivobase Car situation*, Figure 3),
- exposure solely to mobile phone radiation. Here, sham-working artefacts resembling both working devices were used. (*Control situation*; in Figure 4 one can clearly see the mobile phone that provided the radiation).

Figure 2: Demonstration of the test session. Vivobase Mobile or the control device is placed in the right pocket of the testee. For a better visual representation, in the image, the device is placed halfway out of the pocket.

Figure 3: Demonstration of the test session during testing the presumed protective influence of Vivobase Car against mobile phone radiation on the human organism. Vivobase Car is placed 30 cm away from the testee's body.

Figure 4: Demonstration of the test session during testing the supposed protective influence of Vivobase Mobile and Vivobase Car against mobile phone radiation on the human organism. The mobile phone is located beside the testee's head and turned towards the chair through the measurement so that the testee cannot know when the call is performed. After placing all the sensors on the testee, the latter sits for 45 minutes while physiological parameters were measured.

2.4 Testing implementation and protocol

Tests were conducted from July 18 to August 4, 2022 at the BION Institute with 30 testees aged 19 to 74 (twenty females and ten males) that 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. It ruled out the effects of other factors as much as possible (e.g., the testee could be tired after several 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). The testees sat for 45 minutes in a comfortable wooden chair. During this time, physiological parameters were measured, as presented in Figure 4. An 8-channel Biosignalsplux device was used to measure the aforementioned physiological parameters. The phone was placed near the testee's head so that the screen faced the chair. The mobile phone was set to function only on the GSM frequencies (Wi-Fi and Bluetooth were turned off). It was muted, with brightness set to a minimum in all measurements. Consequently, the testees couldn't know when the call was performed (Figure 4). Then the physiological measurements started (**Part A**, mobile on standby, primary standby phase). After 20 minutes, the test assistant called the mobile phone from another cell phone and left it ringing for 5 minutes by redialing as needed (**Part B**, the calling phase). In this phase, the microwave radiation is much higher than in Parts A or C. After that, the physiological measurements continued for another 20 minutes (**Part C**, secondary standby phase). The vast majority of the testees have long-term testing experiences involving various devices and tend to be quite indifferent regarding various testing situations. After the beginning of the measurements, the test assistant left the testees alone in the room.

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 data analysis was performed. Next, the two most extreme outliers were removed so that the presented analysis of data and the outcome were 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. Thorax expansion data analysis yielded 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 corresponded to the time needed for the testee to calm down at the measurements' beginning. Next, a geometric median of all testees was calculated for each measured physiological parameter. Three-time groups, each one 10 minutes in length, were selected. The first represents the time before the call (time window 5 min - 15 min) and is marked as Part A; the second is the actual time of the call (20 - 25 min), including the consecutive five minutes (time window 25 min - 30 min) and is marked as Part B. The third period represents the time after the call (35 min – 45 min time window) and is marked as Part C. Geometric medians were then resampled so that each 10 min time window (part) 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 the already said three parts (Parts A, B, C) and statistically evaluated for every parameter and each part separately.

2.6.2 Statistical analysis and evaluation

To check 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 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 mobile phones, the outcome of the testing should have at least three statistically significant differences (after Holm-Bonferroni correction) in Parts B and C.

3 RESULTS WITH DISCUSSION

3.1 Vivobase Mobile testing

3.1.1 Overall statistical differences in physiological parameters

An overview of the Wilcoxon signed-rank test (paired test) results after the Holm-Bonferroni correction for multiple comparisons demonstrates that there are statistically significant differences between the two experimental situations for heart rate (HR) in Part A and Part B, the muscle tension (EMG) in Part B and the respiration rate (RR) in Part A and Part C. For the skin conductance parameter (SC) in all three parts, there are highly statistically significant differences between the two situations, and also as for finger temperature (TEMP) in Part A and Part B (see Table 1).
As for the differences in variance, after the Holm-Bonferroni correction, only one statistically significant difference was found in EMG part C ($p = 0.011$). Therefore, for the vast majority of results, there are no significant differences in variance, so the table is omitted.

Table 1: Summary of Wilcoxon signed-rank 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 normally represent significant differences ($0.001 < p < 0.05$), 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	0.004	0.277	**0.001**	0.005	**0.001**
Part B	0.026	0.018	**0.001**	1.000	**0.001**
Part C	1.000	0.934	**0.001**	0.009	0.908

[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.

3.1.2 More detailed results per parameters

In the following, boxplot graphs are presented for each measured parameter belonging to both situations and all three 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 Vivobase Mobile situation shows a highly significant difference compared to the Control situation in Part A and a significant difference in Part B (calling phase). It signifies an invigorating effect on the vegetative system during submission to enhanced microwave radiation from the mobile phone.

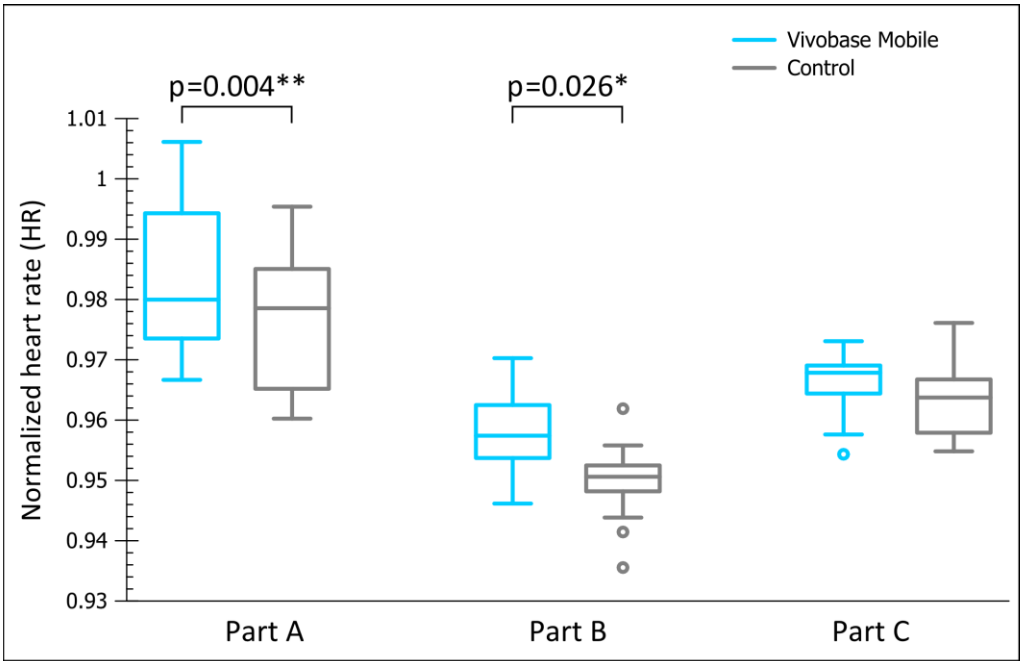

Figure 5: Normalized heart rate (HR) from the testees during three parts of measurements for two test situations. N = 15, each point taken from the geometric median of 28 testees. The single asterisk (*) marks a statistically significant difference between two situations with $p < 0.05$. The double asterisk (**) marks a high statistically significant difference between the two situations with $p < 0.01$.

Muscle tension (EMG, Figure 6) shows lower values for the Vivobase Mobile situation compared to the Control one, significantly in Part B – the calling time with higher radiation. The result indicates that Vivobase Mobile has a relaxing effect on the somatic system, while the exposure to mobile phone microwaves was at its highest point.

In Figure 7, skin conductance (SC) for the Vivobase Mobile situation shows very high significant differences compared to the Control situation in all three parts. The observed differences confirm those of the heart rate and speak of an invigorating effect on the vegetative system during exposure to the enhanced microwave radiation of the mobile phone.

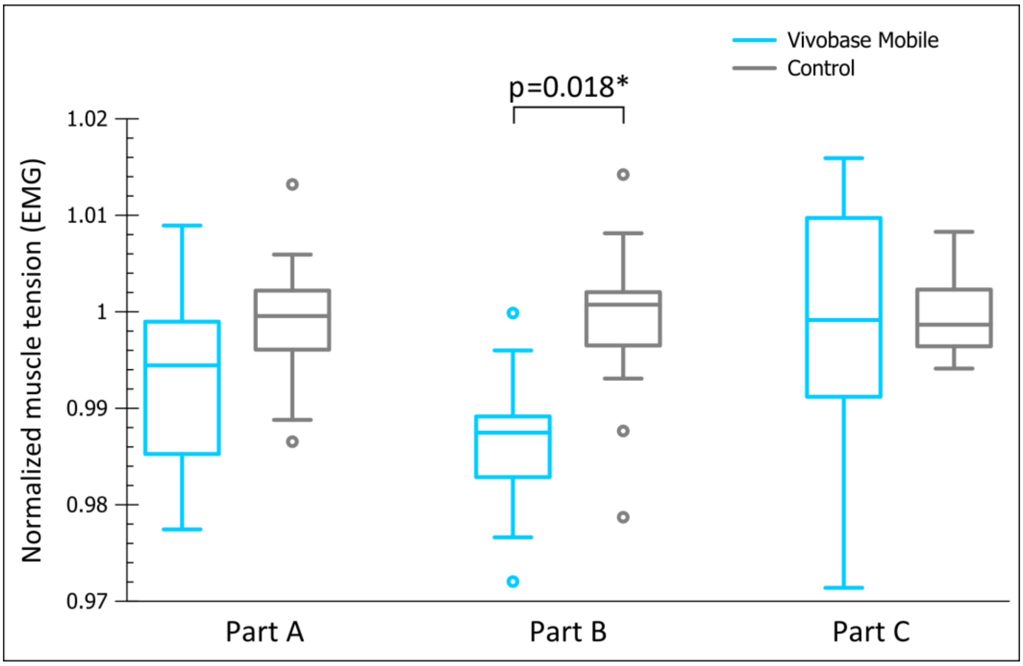

Figure 6: Normalized muscle tension (EMG) from the testees during three parts of measurements for the two test situations. N = 15, each point taken from the geometric median of 28 testees. The single asterisk (*) marks a statistically significant difference between the two situations with $p < 0.05$.

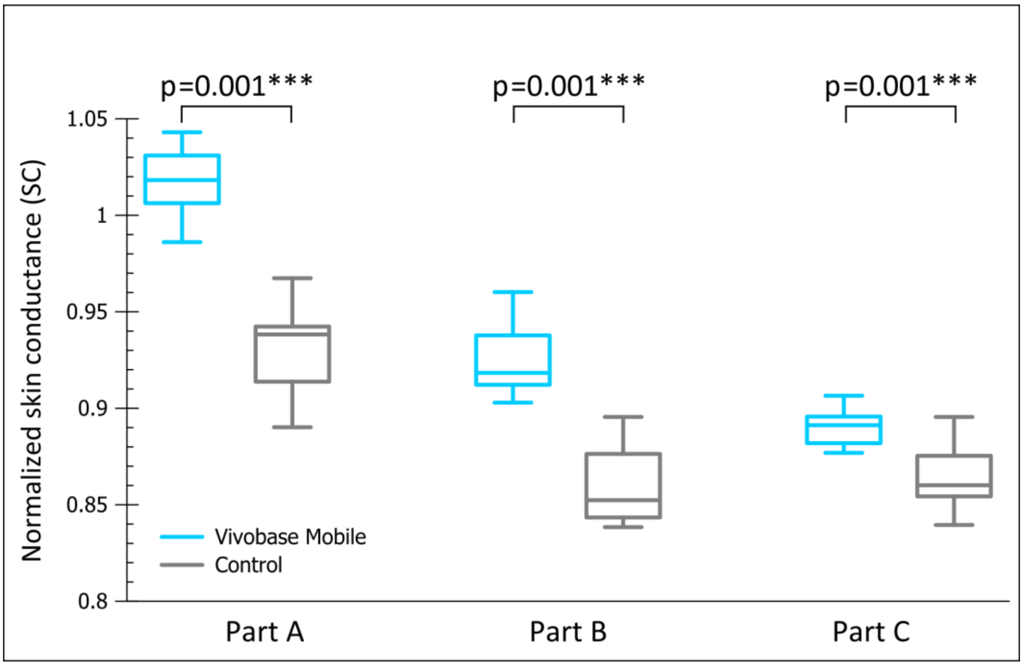

Figure 7: Normalized skin conductance (SC) from the testees during three parts of measurements for the two test situations. N = 15, each point taken from the geometric median of 28 testees. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

Respiration rate (RR, Figure 8) shows highly significant differences in Part A and Part C for the Vivobase Mobile device compared to Control situation. Its higher values signify an invigorating effect on the vegetative system during exposure to the enhanced microwave radiation of the mobile phone, which confirms similar effects on the heart rate and skin conductance.

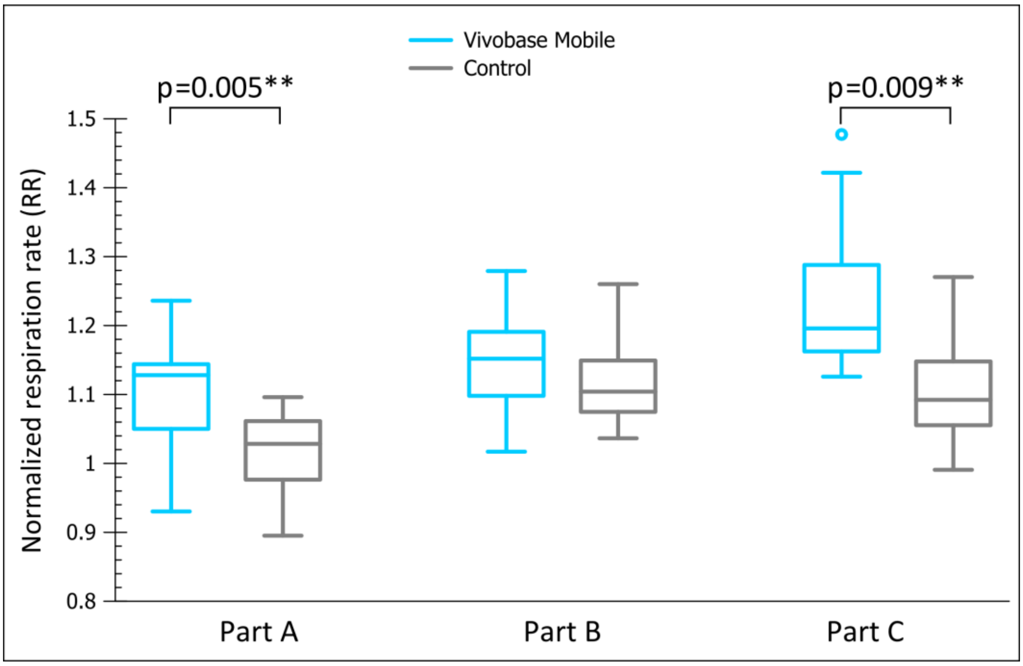

Figure 8: Normalized respiration rate (RR) from the testees during three parts of measurements for the two test situations. N = 15, each point taken from the geometric median of 28 testees. The double asterisk (**) marks a high statistically significant difference between the two situations with $p < 0.01$.

Finger temperature (TEMP) in Figure 9 shows very high statistical differences in Part A and Part B for the Vivobase Mobile device compared to Control. This effect may be interpreted as relaxing.

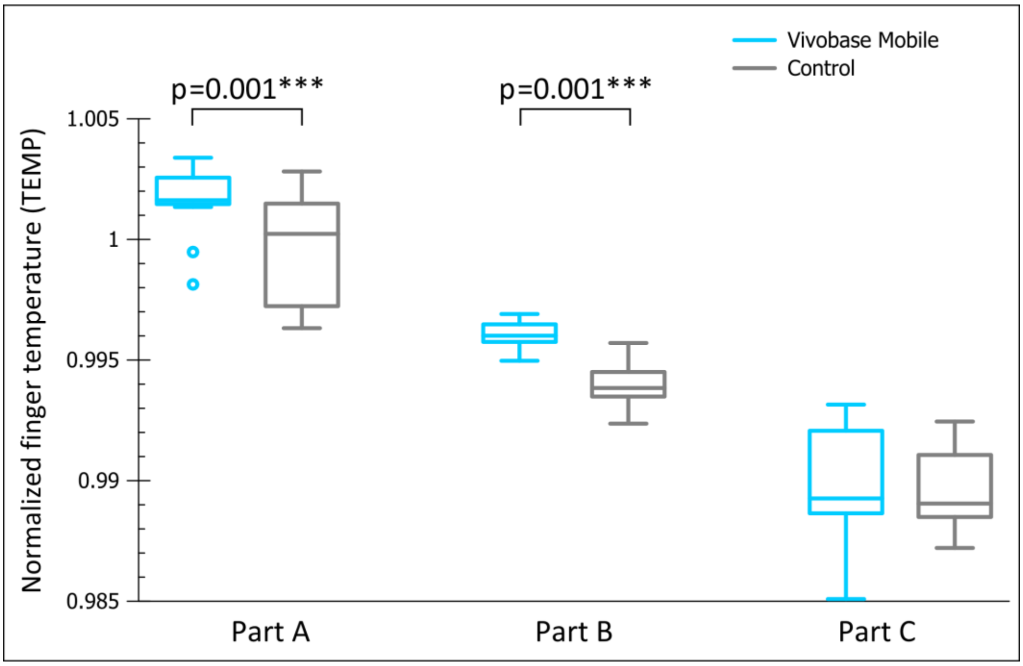

Figure 9: Normalized finger temperature (TEMP) from the testees during three parts of measurements for the two test situations. N = 15, each point taken from the

geometric median of 28 testees. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

3.1.3 Standardized effect size of Vivobase Mobile vs. Control situation

Besides statistical differences in significance, 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 2 below. The latter shows an overview of the effect size for the measured physiological parameters in the three measurement parts.

Table 2: Cohen's D effect size for the measured physiological parameters. Negative values (blue colour) mean that the Vivobase Mobile decreased the parameter values compared to the control, while positive values (red colour) signify a relative increase in the parameter values. 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 designates the difference in 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.

	HR	EMG	SC	RR	TEMP
Part A	<u>0.57</u>	-0.75	<u>4.43</u>	<u>1.23</u>	<u>1.02</u>
Part B	<u>1.20</u>	<u>-1.61</u>	<u>3.50</u>	0.42	<u>2.55</u>
Part C	0.45	-0.07	<u>2.19</u>	<u>1.49</u>	0.04

As may be observed from Table 2, with the exception of TEMP, red-coloured parameters (HR, SC, RR; vegetative system) indicate an invigorating influence of Vivobase Mobile. The heart rate parameter (HR), representing a deep level of the vegetative system, displays a highly stimulative influence. Its maximum lies in Part B, where the exposure to microwaves was at its utmost. Skin conductance (SC), treated as a more superficial level of the vegetative system also shows a highly stimulative effect, but its course is decreasing. A similar effect in respiration rate (RR) may be observed, only here, the course is different, having its maximum at the final part (C). It seems as if respiration reacted to the Vivobase Mobile with a delay. The finger temperature (TEMP) shows higher values, which we interpret as a relaxing influence. Its maximum is in Part B – the calling phase with higher microwave radiation. Thus, not all aspects of the vegetative system reacted in unison to the influence of Vivobase Mobile while exposed to mobile phone microwave radiation; nevertheless, overall higher invigoration may be seen.

The effect on the somatic system, represented by muscle tension (EMG), was relaxing. The relaxing effect was high, with the maximum in Part B – calling phase. The effect speaks about the focus of the organism on the vitalization of the vegetative system, while the somatic system was not needed, and it was economical for the organism to relax. The effect on temperature (increasing in Parts A and B) corroborates this conclusion and shows that microwave irradiation could have some influence on the human organism in spite of its high thermoregulatory capacities if exposed to such radiation (see Adair 2003, 2012). We may interpret that Vivobase Mobile enhances the organism's thermoregulatory capacities and slows down the drop in surface temperature.

3.1.4 Summary of protective influence

We can see many statistical differences (Table 1) between Vivobase Mobile and Control situations in all three parts, with the highest score in Part B – calling phase (the only exception is the respiration rate (RR)). Cohen's D values (Table 2) are also high, with the average maximum in Part B. In Part C, the differences somewhat faded as if the organism relaxed from the enhanced burden of mobile phone microwave radiation experienced during the calling phase. The observed effects of Vivobase Mobile speak in favor of protection in the sense of increasing invigoration of the vegetative system and a relaxing effect on the somatic system. It can be observed especially in the calling phase with stronger microwave radiation (for further confirmation of the protective influence, see Chapter 4.2).

3.2 Overall statistical differences in physiological parameters for Vivobase Car

An overview of the Wilcoxon signed-rank test (paired test) results after the Holm-Bonferroni correction for multiple comparisons shows that there are statistically significant differences between the two experimental situations for heart rate (HR) parameter in Part C. There are statistically significant differences in Part B and highly statistical differences in Part C for the muscle tension (EMG) parameter. High statistical differences are in Part A and Part C for the skin conductance (SC) parameter. A significant difference between the two situations for respiration rate (RR) in Part B (see Table 3) also appeared; its p-value is higher than 0.05, however, following the estimation methodology described in Chapter 2.6.2 because of its high Cohen's D (see Table 4), we treat it as significant.

Table 3: Summary of Wilcoxon signed-rank test corrected with Holm-Bonferroni correction for multiple comparisons. Values written in grey represent statistically insignificant differences between the two experiment situations ($p > 0.05$); values written normally represent significant differences ($0.001 < p < 0.05$) 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.

	HR	EMG	SC	RR	TEMP
Part A	0.847	0.443	**0.001**	0.991	0.677
Part B	0.583	0.022	0.642	0.084	0.991
Part C	0.002	**0.001**	0.002	0.431	0.750

Regarding differences in variation, after the Holm-Bonferroni correction, even one statistically significant was not found. Therefore, we omit the table.

3.2.1 More detailed results per parameters for Vivobase Car

In the following, boxplot graphs are presented, for each measured parameter belonging to both situations and all three 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.

Heart rate (HR, Figure 10) shows a high statistical difference in Part C for the Vivobase Car device exposure situation compared to the Control situation. It signifies an invigorating effect on the vegetative system during submission to enhanced microwave radiation from the mobile phone. A delay in the reaction may be observed since the significant difference shows itself only in Part C and is only indicated in Part B (see also Table 4, first column).

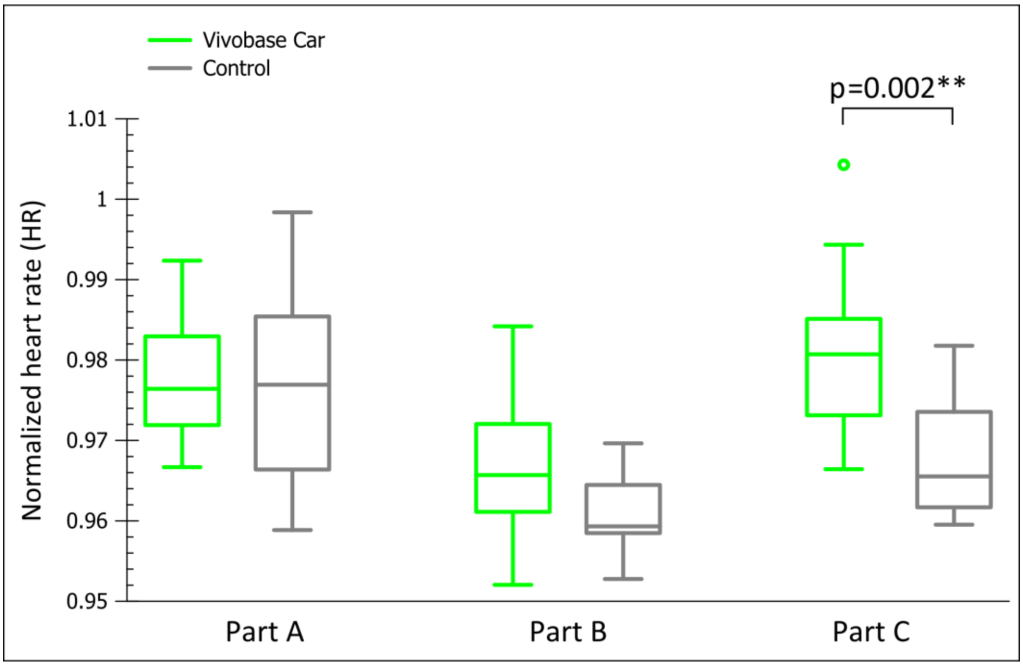

Figure 10: Normalized heart rate (HR) from the testees during three parts of measurements for the two test situations. N = 15, each point taken from the geometric median of 28 testees. The double asterisk (**) marks a high statistically significant difference between the two situations with $p < 0.01$.

Figure 11, representing the muscle tension (EMG), shows a significant difference in Part B and a very high significant difference in Part C. In harmony with Vivobase Mobile testing, the effect of Vivobase Car on this parameter demonstrates to be relaxing (somatic system) and again with a small delay (the highest significance and the highest Cohen's D in Part C (see also Table 4)).

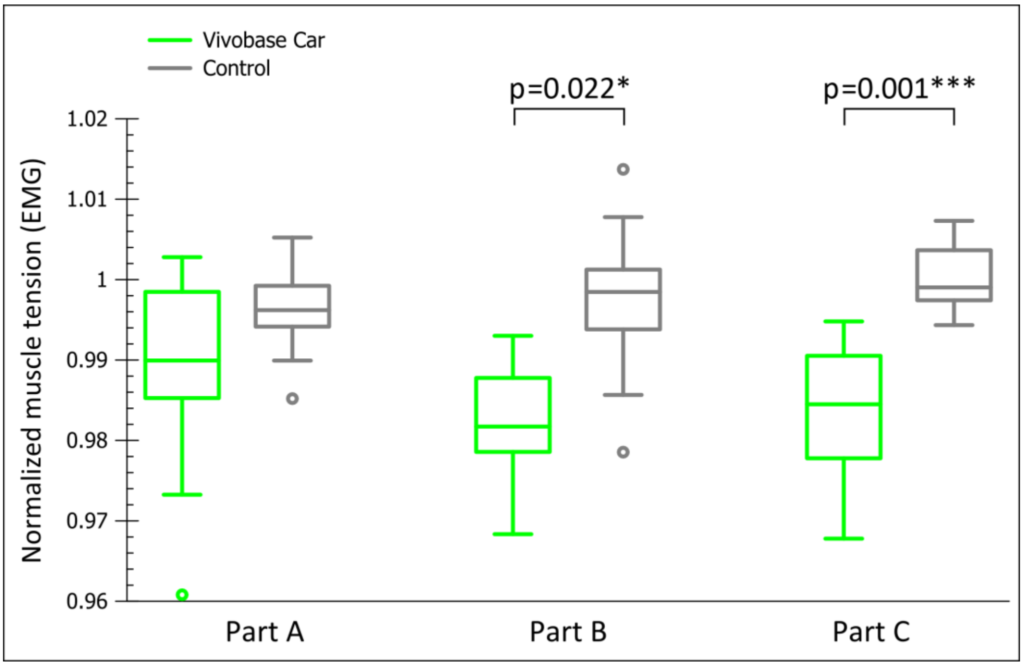

Figure 11: Normalized muscle tension (EMG) from the testees during three parts of measurements for the two test situations. N = 15, each point taken from the geometric median of 28 testees. The single asterisk (*) marks a statistically significant difference between the two situations with $p < 0.05$. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

The skin conductance parameter (SC) shows very high statistical differences in Part A and Part C (Figure 12). The observed differences confirm those of the heart rate and the ones for SC in Vivobase Mobile testing. They indicate an invigorating effect on the vegetative system during exposure to the enhanced microwave radiation of the mobile phone. The absence of effects during the calling phase may be ascribed to a compensating reaction of the body since it strongly reacted to the Vivobase Car influence in Part A.

The respiration rate (RR, Figure 13) shows a significant difference between the Vivobase Car situation and the Control in Part B (see Table 4, column 4). The effect of the device on this parameter shows a relaxing effect in Part B (similar to SC) and a mild invigorating influence in Part C (similar to Vivobase Mobile and HR, SC in Vivobase Car).

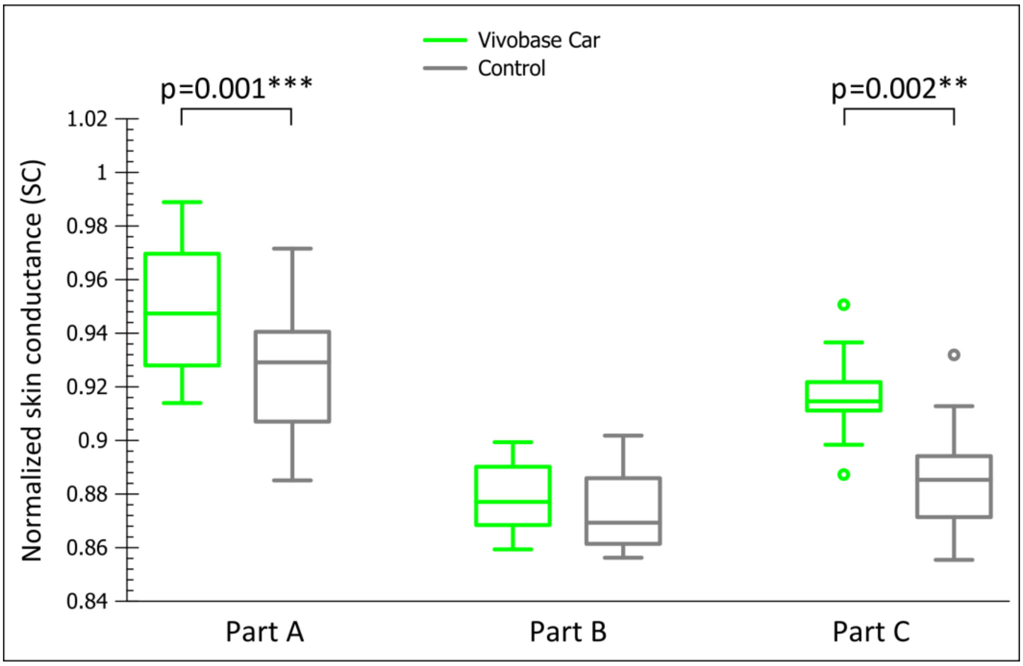

Figure 12: Normalized skin conductance (SC) from the testees during three parts of measurements for the two test situations. N = 15, each point taken from the geometric median of 28 testees. The double asterisk (**) marks a high statistically significant difference between the two situations with p < 0.01. The triple asterisk (***) marks a very high statistical significance of p < 0.001.

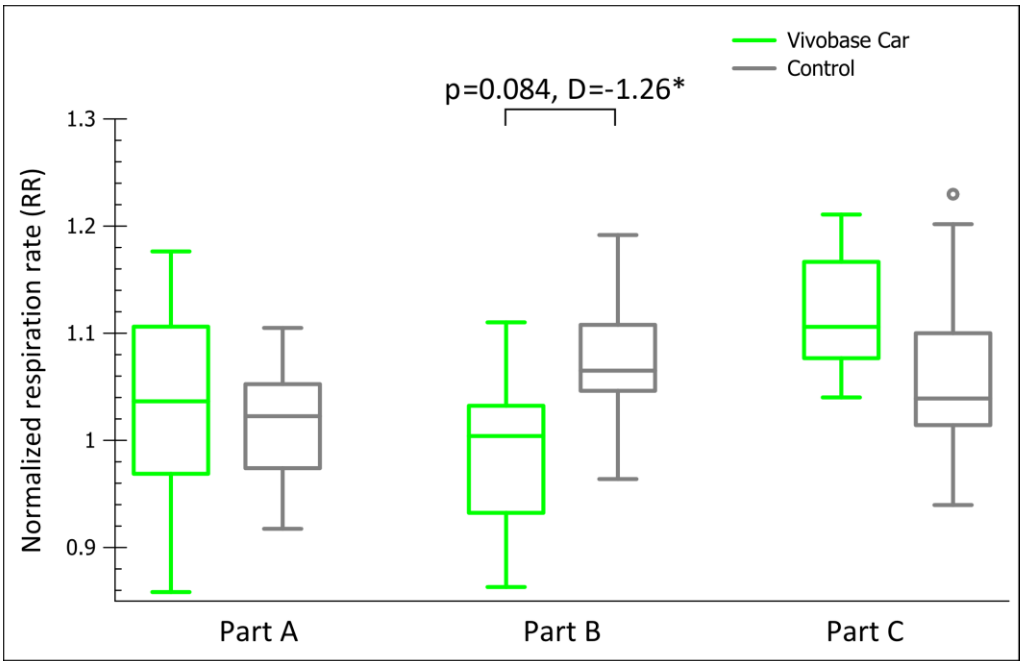

Figure 13: Normalized respiration rate (RR) from the testees during three parts of measurements for the two test situations. N = 15, each point taken from the geometric median of 28 testees. The single asterisk (*) marks a statistically significant difference between the two situations with p < 0.05, or p < 0.1 with absolute Cohen's D above 0.5.

The finger temperature parameter (TEMP) shows no statistically significant differences (Figure 14).

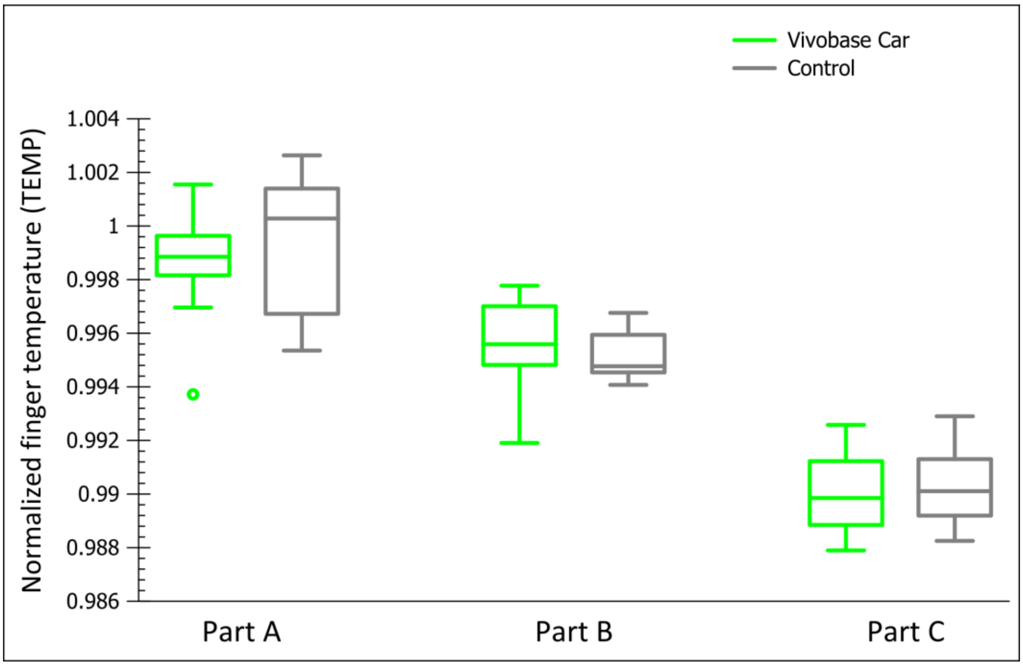

Figure 14: Normalized finger temperature (TEMP) from the testees during three parts of measurements for two test situations. N = 15, each point taken from the geometric median of 28 testees.

3.2.2 Standardized effect size (Cohen's D) of Vivobase Car vs. Control situation

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 4 below. The latter shows an overview of the effect size for the measured physiological parameters in the three measuring parts.

In Table 4, a similar effect as in Table 2 for the Vivobase Mobile device can be seen. Predominantly red-coloured parameters (HR, SC, RR; vegetative system) indicate a general invigorating influence of Vivobase Car. Similar to Vivobase Mobile, the heart rate parameter (HR), representing a deep level of the vegetative system, displays a highly stimulative influence. Only here the effect is highest in Part C (the delay). The effect on skin conductance (SC, more superficial level of the vegetative system) indicates an invigorating effect on the vegetative system during exposure to the enhanced microwave radiation of the mobile phone. The absence of a clear influence during the calling phase could represent a compensating reaction of the body due to its relatively strong reaction in Part A. We could observe that the respiration rate (RR) ultimately shows a stimulative influence, with a relaxing reaction in the calling phase (negative Cohen's D). The finger temperature parameter (TEMP) does not show sensitivity to Vivobase Car; apparently, it

is covered by the high thermoregulatory capacity of the human organism when exposed to microwave radiation (see Adair 2003, 2012).
Muscle tension (EMG), similar to the Vivobase Mobile device, displays a highly relaxing effect; its course is increasing. This, again, shows a delay in comparison to Vivobase Mobile.

Table 4: Cohen's D effect size for the measured physiological parameters. Negative values (blue colour) mean that the Vivobase Car decreased the parameter compared to the Control, while positive values (red colour) signify a relative increase in the parameter values. 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 designates the difference in 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.

	HR	EMG	SC	RR	TEMP
Part A	0.01	-0.83	<u>0.95</u>	0.34	-0.34
Part B	0.74	<u>-1.90</u>	0.31	<u>-1.26</u>	0.37
Part C	<u>1.40</u>	<u>-2.45</u>	<u>1.73</u>	0.83	-0.22

3.2.3 Summary of protective influence

We observe many significant statistical differences (Table 3) between Vivobase Mobile and Control situations in all three parts, with the highest score in Part C – after the calling phase. Cohen's D values (Table 4) are also high, with the average maximum in Part C. We interpret the maximal effect in Part C as an overall delay in response to the influencing field of Vivobase Car. The observed effects of Vivobase Car speak in favor of protection in the same sense as we have seen in with Vivobase Mobile (see 3.1.4 and 4.2).

4 COMPARISONS BETWEEN VARIOUS DEVICES

4.1 Vivobase Mobile and Vivobase Car

Even when discussing the results concerning Vivobase Car testing, we frequently referred to the results of a similar Vivobase Mobile testing. We have already seen that the outcome is very similar, which is understandable since, according to the producer, it should be about the same basic technology. However, following a practical use of both devices, they were differently placed in relation to the body of the volunteer. Hence, it is reasonable to expect also differences. In general, three such differences may be observed:

a) Vivobase Mobile – being closer to the body – exhibits also more noticeable results;

b) the reaction of the volunteer's organism was quicker in the case of Vivobase Mobile than when exposed to Vivobase Car;
c) the influence of Vivobase Car supports relaxation more than Vivobase Mobile.

Taking into account Cohen's D effect size, which is a completely comparable variable among all measurable parameters, in the following figures, the comparison between Vivobase Mobile and Vivobase Car devices is presented. In addition to Cohen's D effect size, a trend line as it develops during three measured parts is also shown. The vertical axis scale is of the same magnitude in all graphs; therefore, the values from different figures can be directly compared.

In Figure 15 (HR Cohen's D), the above-stated general characteristics can be clearly observed when we compare the two testing outcomes: a) both indicate an invigorating influence during the exposure to mobile phone microwave radiation, b) Vivobase Mobile has a little stronger impact then Vivobase Car, and c) the latter shows a delayed influence.

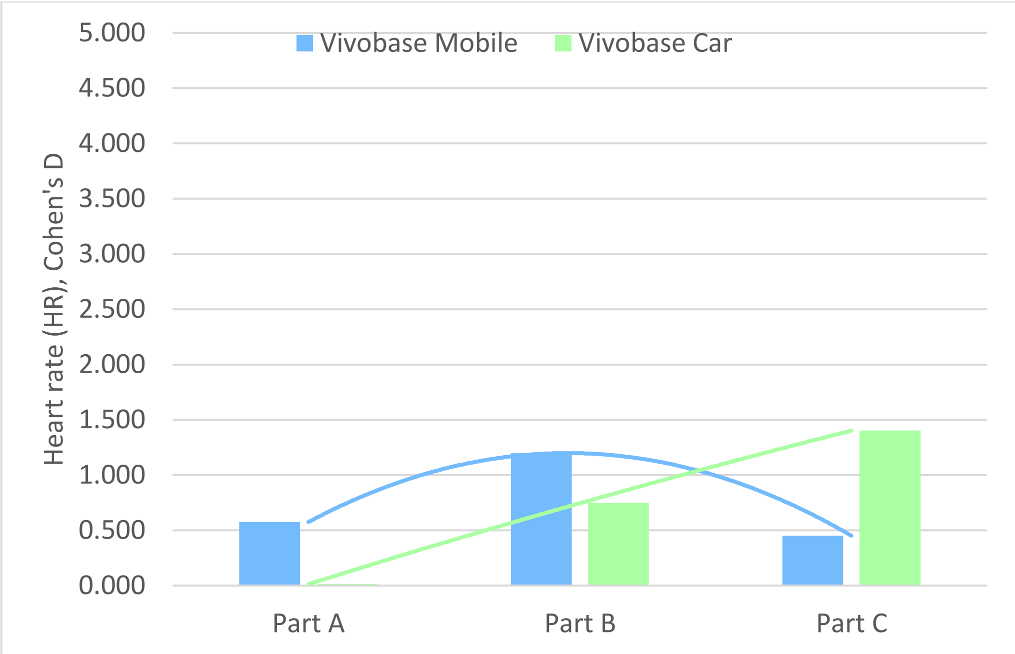

Figure 15: Comparison between the Vivobase Mobile and Vivobase Car using Cohen's D effect size values for normalized heart rate (HR).

For the muscle tension (EMG; Figure 16), it can be seen that both devices' relaxing effects (negative D values) are similar and strong in Parts A and B, but the Vivobase Mobile effect fades in Part C compared to Vivobase Car. Here, the already mentioned difference, namely, that the influence of Vivobase Car supports relaxation more than Vivobase Mobile, clearly shows itself.

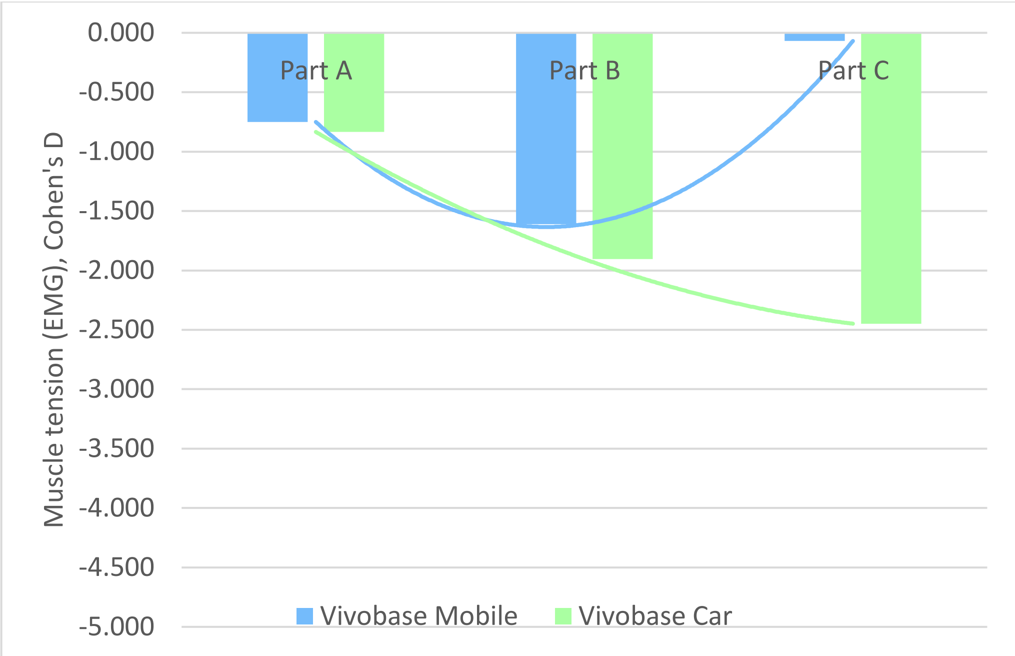

Figure 16: Comparison between the Vivobase Mobile and Vivobase Car using Cohen's D effect size values for normalized muscle tension (EMG).

In line with a similar outcome for HR, Figure 17 shows skin conductance (SC) effect sizes, a stronger invigorating influence of Vivobase Mobile, and a delayed effect of the Vivobase Car device can be seen. The effects of both devices come very close in Part C.

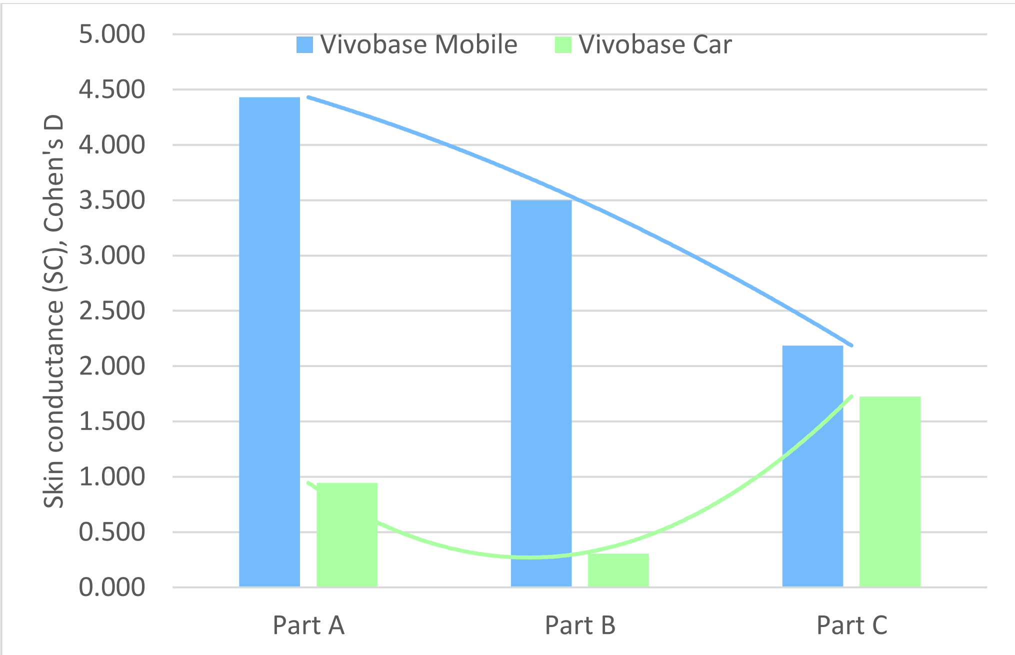

Figure 17: Comparison between the Vivobase Mobile and Vivobase Car using Cohen's D effect size values for normalized skin conductance (SC).

An interesting pattern in Figures 18 (respiration rate, RR) and 19 (finger temperature, TEMP) can be observed, as both devices show tendencies towards relaxation in Part B (calling time). Vivobase Mobile demonstrates a stronger effect than Vivobase Car in the finger temperature (TEMP) parameter.

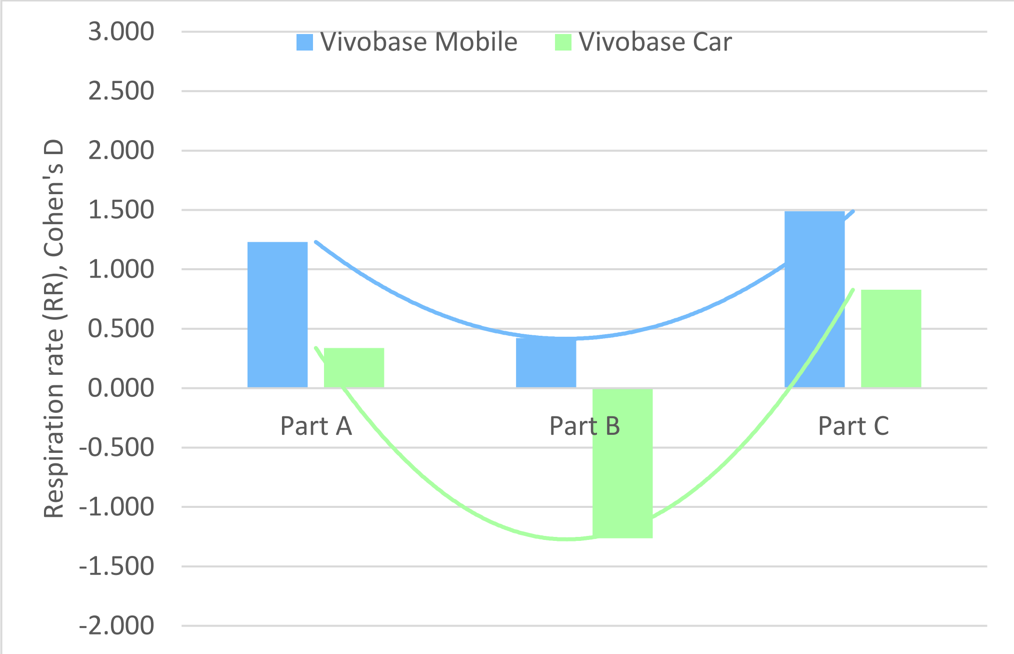

Figure 18: Comparison between the Vivobase Mobile and Vivobase Car using Cohen's D effect size values for normalized respiration rate (RR).

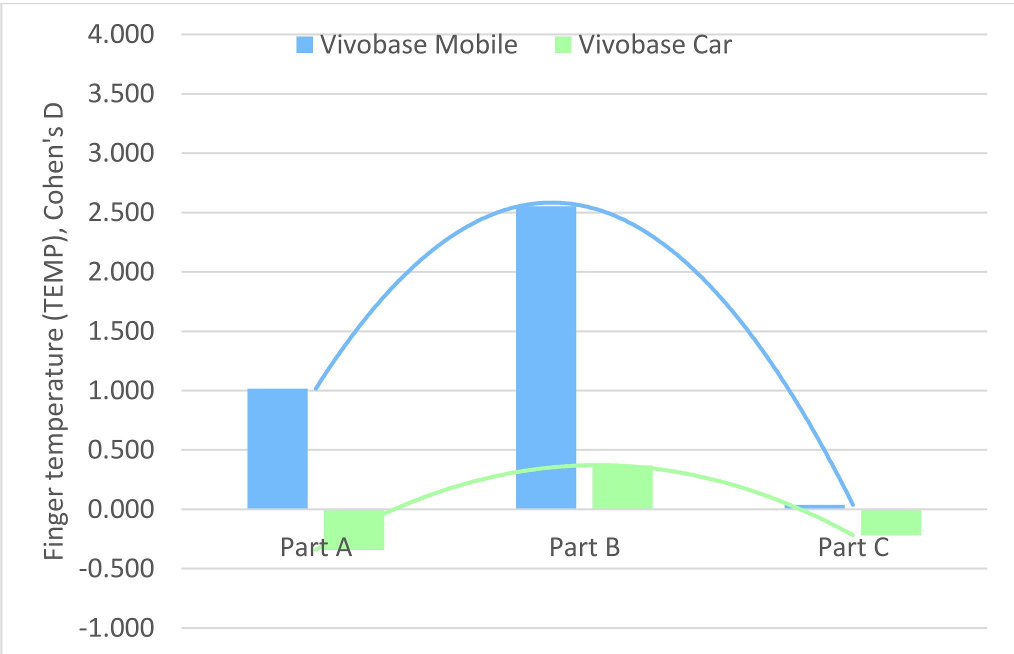

Figure 19: Comparison between the Vivobase Mobile and Vivobase Car using Cohen's D effect size values for normalized finger temperature (TEMP).

4.2 Further evaluation of the protective effect of Vivobase Mobile and Car through comparison with the Vivobase Home research results

The research of an alleged protective function of Vivobase Home (see Report Vivobase Home) vs. Wi-Fi exposure, which works on the same basic principles as Vivobase Mobile and Vivobase Car, can further elucidate if the observed differences could be ascribed to protection from microwaves. Namely, unlike Vivobase Mobile and Vivobase Car, Vivobase Home testing also involved a Control situation without microwave exposure. Therefore, the findings of the Vivobase Home testing, when we have inferred the protective effect, can give us additional insight into the protective effect of the Vivobase Mobile and Car as well.

With the heart rate (HR), we notice invigoration in comparison to control in all three cases, which strongly supports an assumption of a special energy influence. Muscle tension shows relaxation in all three device testing. Since the testing of the Vivobase Home disclosed that this means a protecting influence, we may safely assume that this also applies to Vivobase Car and Mobile (see Jerman et al., 2023, Table 3 and its interpretation). The same principle applies to Skin conductance (SC; invigoration in all three cases). With Respiration rate (RR), the situation is a bit more complicated since only with Vivobase Car in Part B do we notice a relaxing influence, characterizing RR in testing the Vivobase Home. With Temperature, Vivobase Car had no noticeable influence, while Mobile and Home evidenced a raising of surface temperature, with Home showing obvious protection.

5 CONCLUSION

Testing the protective influence of the devices Vivobase Mobile and Vivobase Car shows high overall statistical differences (meaning differences in p-value and Cohen's D) between the two testing situations for each device (see Tables 1 to 4). In both cases, the testees were exposed to the same procedure and the same dose of mobile phone microwave radiation during the whole time of testing. Since both tests show similar and significant differences in the allegedly protected and unprotected situations, we can conclude that both devices objectively affect the human organism in a way that compensates for microwave radiation, at least to a certain extent. Thereby, the working hypothesis is validated for both devices.

The overall influence on the organism during exposure to mobile phone microwave radiation invigorates the vegetative system and relaxes the somatic system. Despite having a similar impact, there is also a difference between the devices, most probably due to their different placement in relation to the body. There are three main differences:

a) Vivobase Mobile – being closer to the body – also exhibits more pronounced results;
b) the reaction of the volunteer's organism was quicker in the case of Vivobase Mobile than in Vivobase Car;

c) the influence of Vivobase Car tends to support relaxation more than Vivobase Mobile;
d) the comparison with Vivobase Home further sharpens the outcome regarding the protective effect.

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7 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" and "Validating alleged protective effect of Vivobase Mobile and Vivobase Car products on human organism during the exposure to mobile phone microwave radiation"[2] 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.