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Effects of Exposure to Electromagnetic Fields from Computer Monitors on the Corona Discharge from Skin

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ABSTRACT

Experimentation in humans indicates that electromagnetic fields (**EMF**) have detrimental effects. EMF have been reported to induce a wide variety of adverse clinical effects which include: adverse reproductive outcomes, neuro-degenerative diseases, headaches, depression, sleep disorder and fatigue. These effects have been validated by large-scale, double blind clinical studies and clearly indicate that a variety of detrimental effects can occur in humans exposed to EMF from man-made technology.

Exposure of human skin to EMF provokes different effects with large individual variability. In order to analyze the effect of electric and magnetic fields on human skin a new technology called Gas Discharge Visualizationis is being developed.

Gas Discharge Visualization (**GDV**) generates gas discharge images of the air gap around the skin in response to a train of triangular electrical pulses (0.1 second duration, 1000 Hz, 3kV and 10^6 V/s). The electric field initiates electron-ion avalanches, which result in a gas discharge along the dielectric surface. The spatial distribution of discharge channels is recorded using a charge coupled optical system, digitized using a video-blaster and mathematically analyzed for several linear and nonlinear parameters including area, fractality and entropy.

GDV images of each of ten fingers were obtained from cohorts of volunteers before and after a ten-minute exposure to EM fields generated by computer monitors. The results seem to indicate that two populations exist, one of which is prone to undergo remarkable changes of skin-surface electric properties, whereas the other seems to maintain unchanged properties in the conditions of the experiment (short exposures). Overall significance was determined using statistical analysis (t-test).

Topical application to the face of a cream specially prepared to shield EMF hemmed the modifications induced by EMF for most of the volunteers exposed to the EMF from a computer monitor irrespective of age and gender. This indicates that topical application of specific materials can protect the skin against the adverse effects of EMF.

INTRODUCTION

Laymen and scientists are becoming increasingly concerned by the effect of electro-magnetic fields [EMF] originating from man-made devices such as Video Display Units (**VDU**) of computers or televisions, cellular telephones, electric wires and overhead power lines [1]. EMF originating from VDU of computers have been extensively studied by the Bio-electromagnetic community. As an example, see for instance reference [2].

From epidemiological observations it can be gathered that people working with computers develop the so-called “screen dermatitis”, characterized by rosacea-like symptoms such as itch, heat sensation, pain, erythema, papules and pustules. People affected by “screen dermatitis” present with specific histological features, such as high numbers of

histamine-positive mast cells and somatostatin-positive dendritic cells, even before the exposure to the radiation from the screen [3, 4]. This is to say that the general population comprises people prone to react heavily to the exposure to VDU with immune responses and with the release of histamine. Microwaves in the range of frequencies used for cellular phones have been shown to increase chromosomal aberrations in cultured V79 cells [5] and in human lymphocytes [6], and to increase the release of histamine from mast cells [7]. In rats exposed to these microwaves, there is an increase in the number of benzodiazepine receptors [8], which are responsive to anxiety and stress. Neural transmission also is affected by microwaves, since it has been shown that cholinergic activity decreases in rats exposed to microwaves, and all the three opioid receptor subtypes are involved in the phenomenon [9]. These results, extrapolated to man, could account for the headaches and other diseases found to be associated with the use of cell phones.

50-60 Hz EMFs have several biological effects. Among them one finds the capability to affect intracellular Calcium transport and induce Calcium oscillations in cultured cells [10]. It can thus be expected that these EMFs interfere with Calcium-induced differentiation of keratinocytes and also that, by modulating Calcium activity, they might provoke cellular necrosis and the consequent inflammation.

For the immediate relevance to human well being, it appears that the EMF above share as a common feature, the capability to trigger the release of histamine, and thus to provoke itch, redness, pain, papulae and pustules. There are reports, which suggest that EMF might affect the mental well being by interfering with the proper functioning of neural physiology and thus provoke headaches, migraines, anxiety and stress.

Human skin is a very complex organ and a same cause, such as the exposure to EMF, might have in different individuals, consequences of different extent. The clinical observations could in some instances be elusive and the clinical relevance of phenomena resulting upon exposure to EMF might be difficult to assess. It is therefore necessary to identify a parameter of the skin, which could be used as endpoint when exposing humans to electromagnetic fields.

This chapter describes a methodology to acquire information on the electric properties of the surface of the skin by analyzing the glow discharge generated when the skin is subjected to trains of triangular electric pulses. These properties are modified when the skin is exposed to EMF generated by computer screens.

Materials able to shield EMF from VDU and 50-60 Hz are at hand: these frequencies are the most likely to be perceived as skin damaging, and these materials are advantageously used in skin care products claiming the capability to shield these EMFs. After topical application of creams able to shield or dampen the intensity of electromagnetic radiation, the electric properties of the surface of the skin are less prone to undergo the modifications induced by the exposure to electromagnetic fields.

MATERIALS AND METHODS

Principles of the experimentation

GDV Technique allows the monitoring of individual reactions to different treatments [11,12,13]. The experiments was performed with healthy volunteers from 18 to 40 years old. Control measurements (before exposure to EMF) were taken when subjects had remained in a computer-free environment for at least 20 minutes. The computer monitor used for measuring changes in GDV was a standard electron-beam tube computer monitor with 17'' screen. Control measurements with computer turned on and off without turn on the monitor demonstrated that the GDV signal was constant for volunteers not exposed to EMF.

The Gas Discharge Visualization

Measurements of individual reaction to EMF have been performed using Gas Discharge Visualization (GDV) technique[11], which generate images of the air gap around the skin during the glow discharge consequent to the stimulation of the skin with a train of triangular electrical pulses. The electric field initiates electron-ion avalanches, which result in a gas

discharge along the dielectric surface. The spatial distribution of discharge channels can be recorded using a charge coupled optical system, digitized using a video-blaster and mathematically analyzed for several linear and nonlinear parameters including area, fractality and entropy. Measurements are taken from the 10 fingers of a subject. Average basic parameters of the fingers glow patterns (**BEO-grams)**: area, density, spectrum, entropy, and fractality can be calculated as described elsewhere [11]. The values of the parameters were calculated for the ten fingers of the left and the right hands and averaged. The GDV Camera used in these experiments was produced by Kirlionics Technologies International, Saint-Petersburg, Russia, and had the following parameters: single impulse duration 10 microseconds; repetition frequency 1000 Hz; induction interval 0,5 s; electrode voltage 3 kV.

Statistical processing.

Data of all measurements were processed statistically with standard software packages STATISTICS and SPSS. Different types of group data analysis: t-test, Kolmogorov-Smirnov test and Wilcoxon test demonstrated consistent results in all trials. This confirms our previous conclusion[11] that distribution of the GDV parameters for semi-uniform group of more than 20 people has quasi-Gaussian character. Parametric inter-correlations were studied with multi-parametric factor analysis.

EMF Protective Creams.

Special creams for the protection against EMF radiation have been developed by the Estee Lauder research team. The principle of protection was to prepare oil-in-water emulsions in which the water phase contains electrolyte and magnetic particles, which oscillate when submitted to electromagnetic waves and thus absorb energy and reduce the intensity of the EMF. The creams were a simplex control emulsion (base), a simplex emulsion containing inert powders (sham) or base added with electrolytes and magnetic particles (anti-EMF cream).

Protocol of experimentation.

Three separate populations were tested by taking GDV photographs before, 10 minutes after subjects sat in front of a computer and ten minutes later after sitting in front of a computer with various creams applied to the face. Initial measurements were taken only when the subjects had remained in a computer-free environment for at least twenty minutes. Seven subjects used the simplex emulsion with no actives (control), 13 additional subjects used the simplex emulsion containing the EM SP ceramic and 13 more subjects used the simplex emulsion containing our anti-EMF technology consisting of a mixture of granatite, fuscite and salt.

Stage 1

1. The volunteer being examined is sitting in a comfortable position in front of the computer (turned off). GDV images of the 10 fingers are taken.
2. The Computer is turned on, after a 10 minutes interval the images of the 10 fingers are taken
3. The Computer is turned off, after a 10 minutes interval the images of the 10 fingers are taken

Stage 2.

1. The volunteer being examined is sitting in a comfortable position in front of the computer [turned off]. GDV images of the 10 fingers are taken.
2. The Computer is turned on; after a 10 minutes interval the images of the 10 fingers are taken
3. The Computer is turned off, The Cream is applied to the face, the Computer is turned on, after a 10 minutes interval the images of the 10 fingers are taken.

For every participant at stage 2 three sessions with different creams were performed.

RESULTS

A] Effect of EMF on the electric properties of skin surface.

Different GDV signals [area and Fractality] were revealed when the volunteers were exposed to computer monitor [Table 1]. No correlation was found with age or gender. No significant effects were seen when pooling the data from all subjects.

Examining before-after differences, two populations emerged, showing increases or decreases in GDV values. The magnitude of these responses varied from less than 10% to approximately 8-fold. Statistical significance was reached only in the population, which showed decreases in both GDV image area and fractality.

Table 1. Type of reaction to the computer monitor.

	GDV Area						GDV Fractality					
	pre	SD	post	SD	p	n	pre	SD	post	SD	p	n
All	5613	2677	5599	2991	NS	41	18.44	6.5	17.74	5.8	NS	41
Increase	5476	3080	6770	3246	NS	22	15.34	6.8	17.94	6.6	NS	18
Decrease	5773	2192	4243	1993	0.03	19	20.87	5.5	17.59	5.3	0.04	23

Table 1: Effect of EMF from computer VDU on GDV area and fractality. Pre – initial; post – 10 minutes after exposure to the computer monitor for 10 minutes; SD – standard deviation; p – statistical probability; NS – not significative; n – number of participants.

B] Effects of different topically applied creams on the modifications induced by EMF on the electric properties of skin surface

The results in the section above indicate that exposure to EMF Radiation emitted from computer monitors dramatically changes the electrical properties of the skin, as determined by the area and fractality of GDV images. We have explored the effect of topical applied creams on these variations. When the exposure to EMF was after topical application of a cream containing the anti-EMF technology, the values of GDV area was very similar to the values of the non exposed control. The results obtained with a cohort of volunteers are reported in figure 1 [average of the GDV areas].

Figure 1

Figure 1: Average GDV areas before or after exoposure to EMF, or after exposure to EMF with anti-EMF cream

When another cohort of volunteers was exposed to EMF from computer screen after treatment with the base alone or with the base containing a powder of inert material, the reduction of GDV area was similar to the one observed for the untreated control. On the other hand, when exposure to EMF was after the application of a cream containing anti EMF technology, the reduction of GDV area was much smaller. The results are reported in Table 2 and the individual outcomes of the experiments are reported in figures 2 A, B and C. The data in Figure 2A indicate that following exposure to computer radiation, nearly all [11/13] individuals using anti-EMF creams showed an increase in GDV area. This effect is clearly less pronounced in subjects using the simplex emulsion with or the simplex emulsion with a ceramic powder [Figure 2B and 2C].

The pooled data for statistical analysis is presented in Table 2, which demonstrates a significant increase [p=0.02] in GDV area following application of the anti-EMF cream [compared to after computer values].

Table 2 Effects of creams on EMF-induced modifications to GDV area

	Group I: Base	**Group 2: Anti-EMF**	**Group3: Inert Powder**

	Average	SD	p	Average	SD	p	Average	SD	p
Initial	7212	2654		6232	3422		7705	2070	
Computer	6747	2364	ns	5011	2565	ns	7067	1820	ns
Comp + Cream	8060	2123	ns	7203	1687	.02	8070	1713	ns

Table 2 Average values of GDV areas for the three groups exposed to EMF

Figure 2: Individual variations of the GDV area [after exposure to computer screen in the presence or in the absence of an anti-EMF cream [A]. a mock ceramic-containing cream[B] or the control simplex emulsion [C]

Figure 3

Figure 3: Individual effect of exposure to EMF in the presence or in the absence of control cream, cream with ceramic powder or anti-EMF ingredients

The data in Figure 3 show the effect of exposure to computer radiation with or without topical application of specific creams. Large inter-subject variations are observed, yet the overall trend is a decrease in area following the exposure to computer-emitted EMF and an increase when the exposure is subsequent to a treatment with anti-EMF creams. Control studies with the computer on and the monitor off showed no effects.

The results are analyzed in depth by scrutiny of figures 4-9. Fig. 4 and 5 display the statistical processing of a group of data [with standard deviation] in initial state, after the exposure to EMF from computer monitor and after exposure with active [anti-EMF] cream applied to the face. From these graphs, it can be concluded that there is no statistically significative difference between GDV area before or after exposure to EMF from computer's monitor. After application of cream, the increase of GDV area and for entropy was statistically significative.

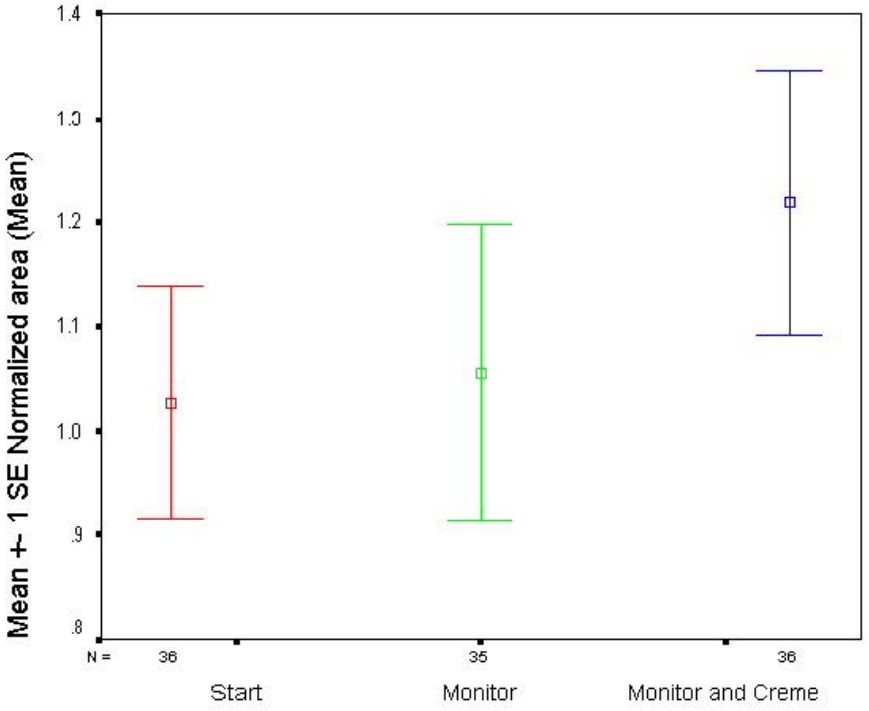

Fig. 4. Pooled data of normalized GDV area and standard deviation for a group of 35 volunteers exposed to EMF with or without anti-EMF cream.

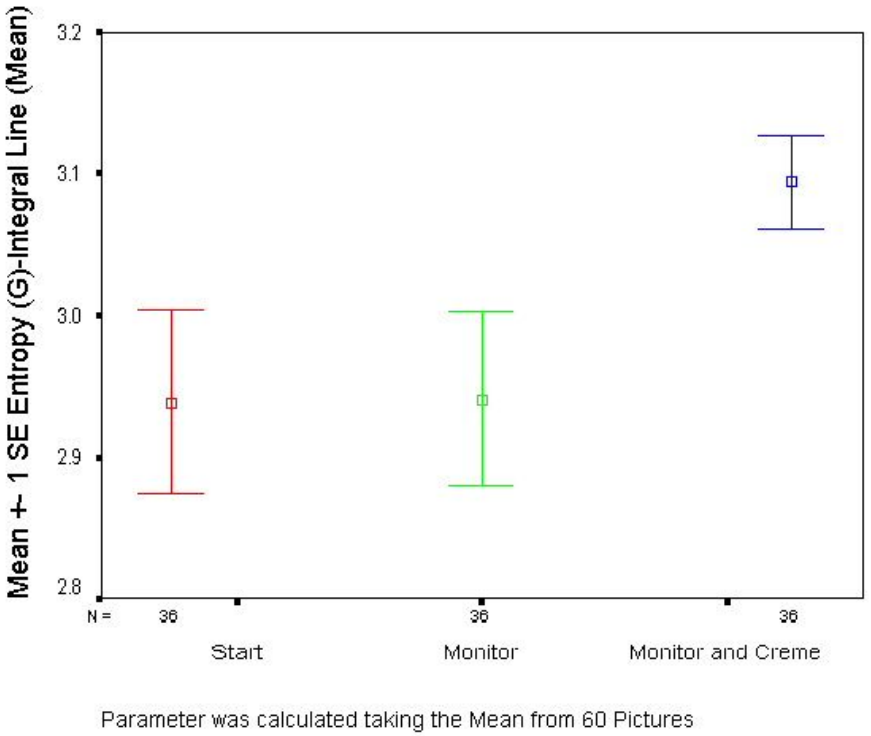

Fig. 5. Pooled data of GDV Entropy [and standard deviation] for a group of 35 volunteers exposed to EMF with or without an anti-EMF cream.

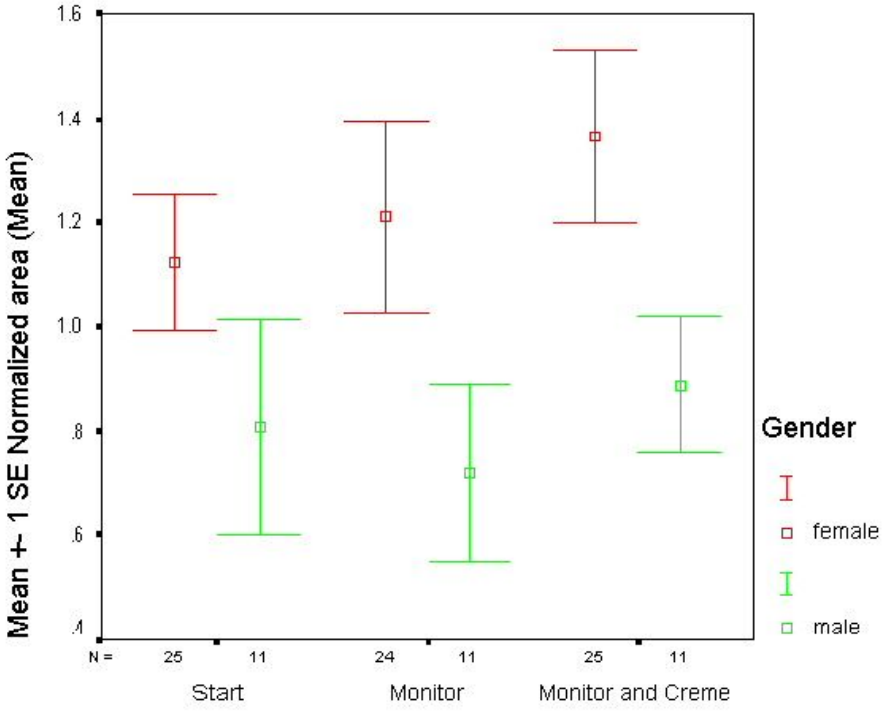

Fig. 6. Pool of data for normalized GDV Area with standard deviation for the groups of females and males volunteers exposed to EMF with or without an anti-EMF cream.

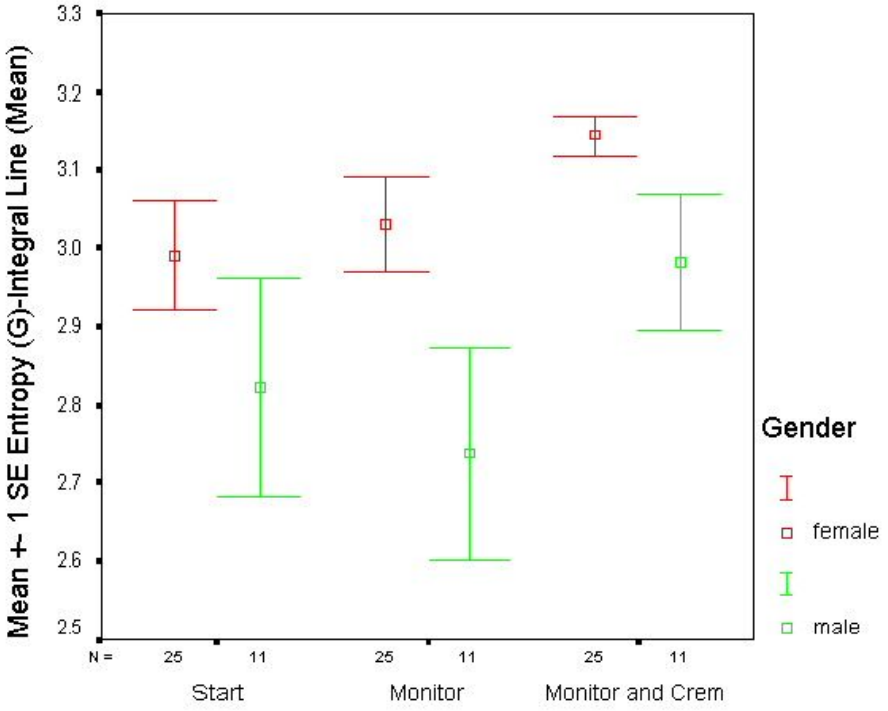

Fig. 7. GDV Entropy with standard deviation for the groups of females and males volunteers exposed to EMF with or without an anti-EMF cream.

Fig. 6 and 7 display data distributed by gender. Females undergo a statistically significative difference between the GDV values before and after exposure to EMF, whereas such a difference is not found, for males. On the other hand, after application of anti-EMF cream, a statistically significative change of GDV parameters for both genders can be observed.

Fig. 8 and 9 display data obtained with different creams. GDV Area is modified by Anti EMF [10073/1] and Inert Powder [10079/2] creams, but practically no statistical group effect of Simplex [10073/4] cream. At the same time GDV Entropy is influenced by the presence of all the creams, but more strongly by Anti EMF and Inert Powder creams compared with Simplex cream.

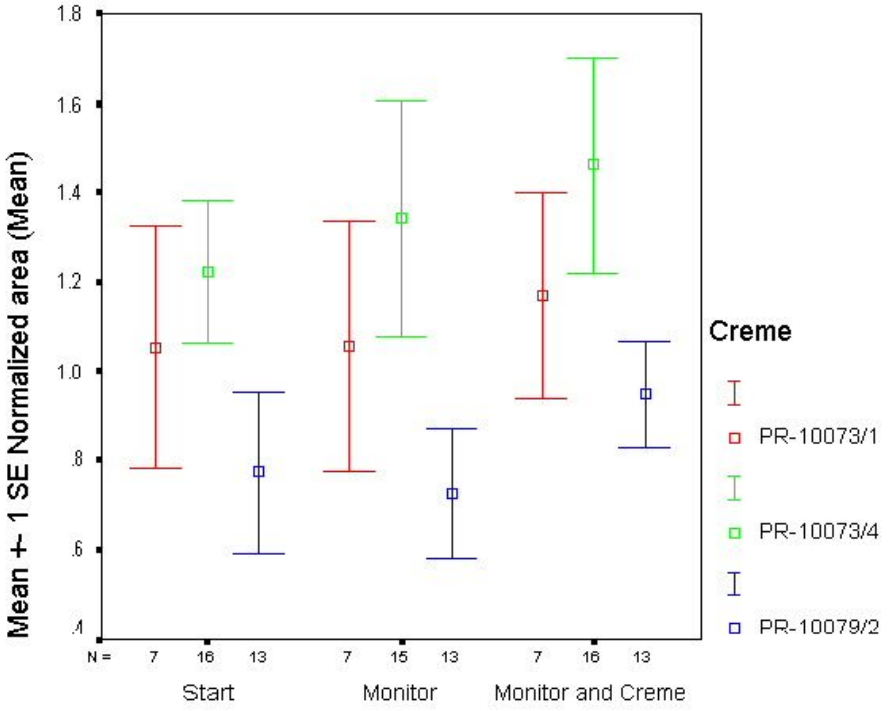

Fig. 8. Pooled of normalized GDV Area with standard deviation for a group of 37 volunteers exposed to EMF with or without different creams.

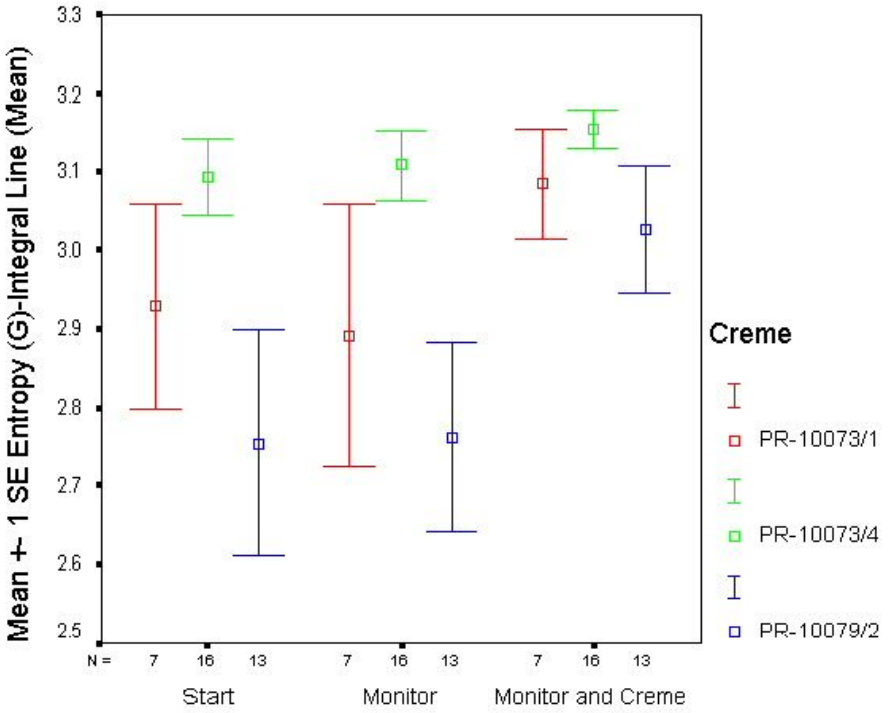

Fig. 9. GDV Entropy with standard deviation for a group of 37 volunteers exposed to EMF with or without different creams.

DISCUSSION

Data reported in this chapter demonstrate that reaction to the weak EMF strongly depends on the individual. It has the effect of modifying the area and fractality of GDV images on about 50% of the population studied. This correlates with results of other studies. The results indicate that radiation emitted from computer monitors inhibits corona discharge formation at the surface of the skin. Both linear and nonlinear measures showed statistically significant changes. The fact that only 50% of the population show a sensitivity to computer monitor radiation is of further interest.

Human organs possess different electrical properties in accordance with the frequency and intensity of the applied external EMF [23]. At some frequencies can behave as conductors, at others frequencies as dielectrics. Different content of water in tissues dictates different electrical and screening properties. For example, the brain is a paramagnetic tissue suspended in diamagnetic liquor that provides screening from the environmental magnetic fields, in particular from the variations of the geomagnetic field [16, 20, 21].

People display pronounced physiological reactions to the variation of the geomagnetic and artificial EMF: changes of arterial pressure, heart rate variability, breathing frequency, Na+/K+ exchange rate, and other parameters were recorded in multiple studies [19, 11, 12, 13]. The level of these reactions depends on the type of central nervous system, age, gender and current physiological state of a person [14, 15, 17, 18, 22]. Possibly, there are critical days for every person, when physiological systems are most sensitive to the influence of natural and artificial EMF. We can conclude, that development of different means for protection from weak EMF is a task of practical importance.

Protective creams aimed at creating a thin conductive layer on the skin that prevents accumulating of surface charges results in successfully dampening of the intensity of the electric field and in the measurable reduction of the effect of EMF on area and fractality of GDV images.

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