About the stability of the changes in the points-sources

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ABSTRACTS. Here we represent the result of a three-year study conducted at the Department of Medical Informatics. The study consisted in comparing of electrocutaneous characteristics in the points-sources at all the meridians of volunteer participants, identified before they start working in ergatic computer learning system, and after the end of this work. The results showed a statistically significant changes in the electrocutaneous characteristics under the influence of such work and the stability of such changes.

I. THE AIM AND METHOD

To establish the possible impact of the computer ergatic system on the changes in the person ‘sfunctional state and to confirm the informativeness the electroskin resistancein the points-sources (PS) method in determinationof the changes in the human functional state while using the computer. The main element of the study was the measurement of electroskin conductivity in men's special acupuncture points(points-sources of meridians) and finding a possible difference between the values, received after the occupation, in comparison to the same performance, recorded before the beginning of the work in computer ergatic system. Statistical evaluation of the results carried out using STATISTICA 6.0 program. The effectiveness of the method used is validated statistically. The study confirmed the stable distributionof electroskin potential over the surface of human body in the studied acupuncture points.

II. RESEARCH

The urgency of the problem lies in the fact that the number of people using computer technology in work, leisure and education, benefiting from access to the Internet, has reached 2 billion and continues to grow at a rapid pace. There are almost no area of human activity that is not covered by the use of computers. They are used in industrial processes, in training, leisure time, by people of all ages. The development of the World Wide Web, the appearance the phenomenon of social networks that enable online - communicate with others at any time, from any location on Earth talks about the introduction in our social and professional lives new ergatic systems "man - computer." Curricula of all schools use the tools of information computer technologies in preparation for lessones, doing school assignments and monitoring of learning. This resulted in the complete processing of curricula to the requirements and conditions of their functioning in ergatic environment. Quick development of distance education is based entirely on the work exclusively in ergatic environment.

Therefore, the maintenance of people health in the emerging environment, offsetting possible negative influence of ergatic systems on people health requires an urgent solution.

As a model of working the man in ergatic system was chosen the studying process in computer class of university. The study consisted of two phases measurements electroskin characteristics (ESC) carried out before the start of the regular school (not the examination or control) 4-hour session in the computer lab, and upon its completion. Lessons include: acquaintance with theoretical material and practical work assignment, execution of practical work, final testing on the theoretical knowledge and practical skills received in the lesson. Teaching and learning material was given only in electronic form, the job was carried out only on the computer.

Surveyed a group of volunteers in a number of 84 people, university students, aged 18-19 years, 35 male and 49 female, in the same time of day - from 12.00 to 16.00 p.m., in order to avoid the influence of circadian rhythms on the overall study. The research season - September. The outside temperature was 24-26 degrees by Celsius scale.

Main control element of used measuring device is so-called Wheatstone bridge with little temperature zero drift, which realizes extremely accurate metering mode.

ESC registration performed by the method of “standard vegetative test CITO” (Electropunctural standard vegetative test (“СВТ ЦИТО”, the authors A.I.Nechushkin and A.M.Gaydamakina) (registration number 10 8/30 of May 27, 1977)) [1], in the PS–“the meridian sources” located at the wrists and ankles, symmetrically on the right and the left, on the negative polarity of the applied DC voltage of 9V,of adjustable force up to 20 micro amps, which is equated to 100 units on the device scale (because of this we can compare the results of different persons with different absolute electroskin parameters). Totally each test was measured at 24 PS before and again at the same points after lessons. Passive electrode was a hollow brass cylinder 120 mm long and 15 mm diameter. The active electrode is brass rounded at the end of the probe to the area of contact to the skin 1.5 mm2. Electrode pressing down force in every PS was dosed by person reaction that there was no discomfort in the form of puncture or pressure to the electrode. Exposition time – 3-5 seconds on every PS.

Test CITO use the same acupuncture points like in Nakatani test, but the difference is the amperage of DC and the kind of the scale [2].

We proposed serious differences in processing the measurement results, comparatively to the test Nakatani and CITO. In Nakatani test the conclusions are based on calculating the average of every patient's total PSs measuring and then the researcher finds the "corridor of valid values" for every one. CITO test also looks on the patient's average and deviations of every PS value from it. In our case we calculate the averages for every PS, and the histogram of these averages shows us the value distribution. If we imagine all the results of measurement are placed in the table, so Nakatani or CITO test calculates the average for every patient as the total sum of the values by the rows; in our method we calculate the average not for patient, but for every PS differently, as the sum of the elements by the columns, build resulting histogram and only after that look for diversities between this resulting curve parameters and parameter of any patient.

All the measurements were recorded in the usual table. [3] For each PS (not for person) was calculated the averages, statistics mode, median, the confidence interval, the standard deviation.

The measurements showed a significant relative difference in the conductivity determined before and after lesson. Such differences on the right and left sides declined by a total of 7%. For some PS relative reduction was over 20%.

We calculated the relative changes of the values ESC received after a lesson, as a percentage relative to the same prior to occupancy. The calculation results are presented in Table 1. The order all the PS are placed in this table is the same with Nakatani test; the names of meridians PS are according to French classification.

TABLE 1. AVERAGE CHANGES; RIGHT AND LEFT SIDES

	Difference, left		Difference, right	
PS	**%**	**p**	**%**	**p**
P	**-3,54**	0,003	**-6,2**	0,033
MC	**4,33**	0,232	**-2**	0,054
C	**-2,6**	0,006	**-6,1**	0,122
IG	**-14,5**	0	**-7,2**	0
TR	**-30,8**	6,20E-05	**-28,4**	2,2E-05
GI	**-25,7**	0	**-18**	0
RP	**-3,61**	9,50E-05	**-5,3**	0,023
F	**-0,63**	0,009	**-0,5**	0,043
R	**-14,1**	8,80E-06	**-14,3**	0,001
V	**-3,99**	2,80E-06	**-10,4**	0,096
VB	**-14,2**	3,60E-06	**-15,8**	1,2E-05
E	**-3,93**	0,21	**3,2**	0,126

Was plotted the ESC averages graph that is shown on Fig.1.

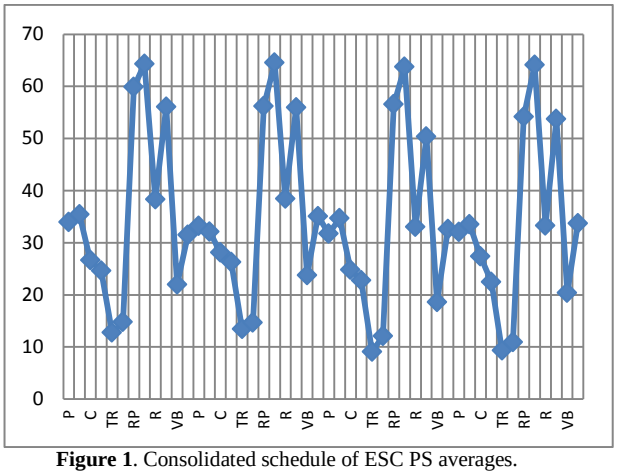

Figure 1. Consolidated schedule of ESC PS averages.

The resulting curve shows the averages results of successive measurements of the right, left side, before lesson, then the right and left side after lesson. Like the table with measurements results is built of four parts - measurements of 12 PSs of the right part of the body, then measurements of the 12 left side PSs, and these are the parameters of the PSs received before the volunteers class work, and then again 12 PSs results of the right side, 12 PSs of the left side, measured after work in ergatic learning system.

Totally was researched 48 points - 24 PSs before lesson and the same 24 after the lesson. All measured values ESC presented sequentially to show the revealed relative stability of the measured values ESC.

III. RESULTS

Chart analysis revealed that the curve, the envelope average values ESC is regular, i.e, fragments of the curve belonging to the right, left side of the body, before, after lesson taking in appearance are similar to each other. Values are not chaotic, but have relatively stable order. The graph reflects it very clearly.

At the same time, the ESC of every single person is not necessarily similar to the presented schedule of averages. Such regularity of ESC PS graph becomes significant only on the sufficient amount of observations; it is valid for ESC PS averages. The Fig.2 illustrates this fact.

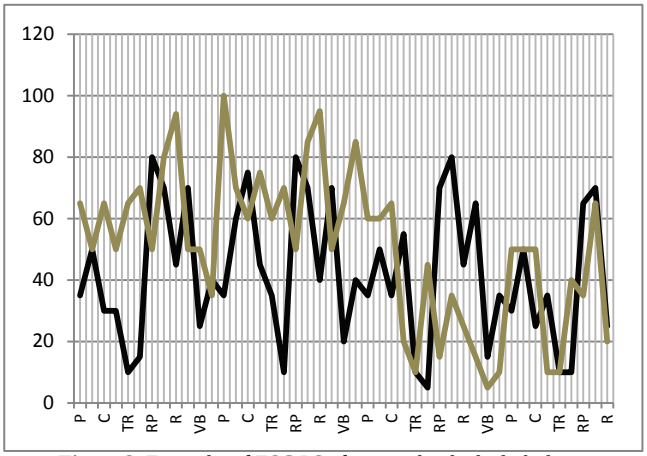

Figure 2. Example of ESC PS of two individuals: light line – male, dark - female.

The measurement results have gender differences. In the Table 2 are placed all the differences between the initial an final measurements in every point – source, in percents.

TABLE 2.THE RELATIVE DIFFERENCES OF THE ESC AS A PERCENTAGE OF BASELINE MEASUREMENTS ON THE RIGHT AND LEFT SIDE OF THE BODY .

	Female, %		**Male,%**	
PS	**right**	**left**	**right**	**left**
P	-9,2	-4,4	3,2	-2,0
VC	-3,5	2,5	4,4	10,0
C	-6,9	-7,5	-8,8	13,9
IG	-3,0	-11,8	-28,2	-29,5
TR	-12,9	-21,7	-47,2	-40,3
GI	-8,0	-21,0	-40,8	-43,7
RP	-4,2	-2,6	-13,7	-9,2
F	1,5	1,5	-12,9	-10,9
R	-10,7	-11,5	-25,0	-21,3
V	-8,1	-3,2	-23,3	-8,6
VB	-16,1	-12,5	-10,9	-20,6
E	-8,3	-4,4	-11,0	-7,2

The relative changes are less pronounced in girls group, but the total girls average ESC PS is lower than boys: 52.19 and 44.40 (a difference of 15%) for males and 32.95 and 31.03 (6% difference) in girls, which is evident from difference table averages [4].

IV. CONCLUSIONS

In the course of study the stability of the selected indicators ESC was found, as evidenced by the regular structure of the graphs. This ESC PS stability proves the objective reality of these "control points" on the body existence of. It testifies about proving the fact of electrodermal potential on the human skin surface distribution and the informativeness of such results. Also, was shown that ESC PS is sensitive method to control the changes in functional state of human body in any, even very low physical or mental or cognitive load [5]. Determination of ESC PS method can be used to find and to control the changes in the people functional state under the influence of different loads [6], it is simple to use, requires no special training for the person conducting the study, the results can be easily processed on a computer using a conventional office programs such as Excel. To compensate the possible violations in functional state of the people working in ergatic systems, we offer a special set of physical exercises, supplemented by special exercises for the eyes and the eye muscles.

Our Department and we personally will continue our research.

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