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Features of Frequency Indices of the Heart Rate of Teachers of Yugra Depending on the Expressiveness of Symptoms of the Emotional Burnout "Resistance" Phase

The author has studied the interrelation of frequency characteristics of teachers' heart rate variability and the degree of expressiveness of symptoms of the "resistance" phase of the emotional burnout syndrome. It was discovered that symptoms of the "resistance" phase among the examined teachers are the most significant. The author has found out that absolute values of frequency characteristics are 1,5–3 times higher than standard values, that is connected with adaptive mechanisms of an organism when living in the territory of Yugra. Absolute values of frequency indices of HF, LF, VLF and LF/HF at the stage of "maturity" of each symptom of the "resistance" phase are higher than similar indices at the stage of "immaturity". It is especially expressed in LF/HF index, and these distinctions are reliably significant for each symptom (when p < 0,01 and p < 0,05 depending on a symptom). Thus, the index of LF/HF can be considered as a marker for assessing the development of symptoms of the "resistance" phase.

Keywords: *emotional burnout, "resistance" phase, frequency characteristics of the heart rate variability.*

Introduction

The state of emotional, physical and intellectual exhaustion resulting from a chronic stress at work essentially changes psychophysiological parameters of the person. The analysis of foreign literature and the literature devoted to studying teachers' emotional burnout (EB) has shown that the most part of researches are directed on establishment of expressiveness of various symptoms of burnout, their dependence on length of service, an educational institution type, the worker's status (I. A. Kurapova, E. O. Nenart, V. E. Orel, K. S. Milevich, etc.). They continue to study factors influencing the development of EB and groups of risk, and also develop actions for prevention and recovery of teachers (O. N. Gnezdilova, N. S. Pryazhnikov, E. V. Leshukova, etc.). The problem of studying psychophysiological changes which are provided by neurovegetative regulation (NVR) at EB development remains a little studied. It is known that the cardiovascular system works under control of genetic factors [2, 3]; however regulation of the circulatory system is very sensitive to adverse factors and reflects the general psychophysiological condition of an organism [6]. In this regard the research purpose was establishment of interrelation of emotional burnout of teachers living in conditions of Yugra with frequency indices of the heart rate variability. The hypothesis of research consisted in that the VLF frequency index changes more than other frequency indices when forming symptoms of emotional burnout as it is connected with psychoemotional tension.

The Methodology

This research was conducted on the basis of comprehensive schools of the Surgut region of the Tyumen region. Teachers took part in the study (217 women, middle age 43,49 ± 1,07, length of teaching experience – 19,25 ± 1,09). The teachers underwent psychological testing by a technique – the test for "Emotional and professional burnout" (V. V. Boyko) [1]; we have also measured indices of the heart rate variability (HRV) by the pulsoxymeter "ELOKS-01S2", with the subsequent analysis of VSR indices by means of the ELOGRAPH program.

According to V. V. Boyko's technique they divide emotional burnout into three phases for convenience: the "tension" phase (experience of emotional tension in connection with dissatisfaction with work, self, etc.); the "resistance" phase (it is characterized by resistance and inadequate response to the organizational aspects in work, contacts with colleagues, etc.); the "exhaustion" phase (avoiding of close emotional and personal contacts, ill health, etc.). The most significant indices of the spectral analysis: VLF, LF, HF and LF/HF were used for an assessment of the neurovegetative regulation of an organism for indices of VSR of teachers-respondents.

According to many authors, the power of a super low-frequency component (VLF) characterizes the activity of the sympathetic department of the vegetative nervous system (VNS) and humoral-metabolic regulation [9]. There is also an opinion [5, 7] that the VLF amplitude is closely connected with psychoemotional tension. The power of the low-frequency component of the spectrum (LF) characterizes the state of the VNS sympathetic department, in particular, the system of vascular tone regulation, namely the vasomotor center of a medulla and its activity decreases with age. The power of the high-frequency component of the spectrum (respiratory waves) (HF) characterizes the activity of the parasympathetic department providing processes of accumulation of energy, relaxation. According to the "International Standard" LF/HF ratio during wakefulness in a quiet state has to be within 1,5–2,0. That is in the afternoon mobilization and power consumption processes prevail, and processes of relaxation and energy restoration prevail at night, and the ratio of LF/HF becomes less than unity.

The Results

In the group of the surveyed teachers by average results in values of the "tension" and "exhaustion" phase are not created, and the "resistance" phase is in a state of formation (fig. 1).

If to summarize the number of teachers who are at stages of formation and maturity of the phases of "tension" (31 % of teachers), "exhaustion" (34,5 % of teachers), and especially the "resistance" phase (75 % of teachers), it is possible to note that symptoms of the "resistance" phase are most expressed among teachers-respondents, which characterize both the state of emotional sphere, and the professional aspects of personality.

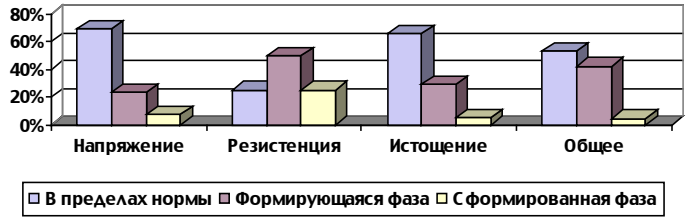

Fig. 1. Teachers' distribution diagram (percentage of the total number of examinees) according to the degree of maturity of each phase of emotional burnout (according to V. V. Boyko's test)

In the group of the surveyed teachers we have made distribution of the total number of teachers depending on the degree of formation of each symptom of the "resistance" phase which includes the following symptoms: V – "Inadequate emotional reaction" (fixing on negative emotions and their demonstration); VI – "Emotional-moral disorientation" (the reduced orientation to honest relations); VII – "Expansion of the sphere of economy of emotions" (avoiding or reduction of contacts); VIII – "Reduction of professional duties" (work "with difficulty" and decrease in the efficiency of work (fig. 2).

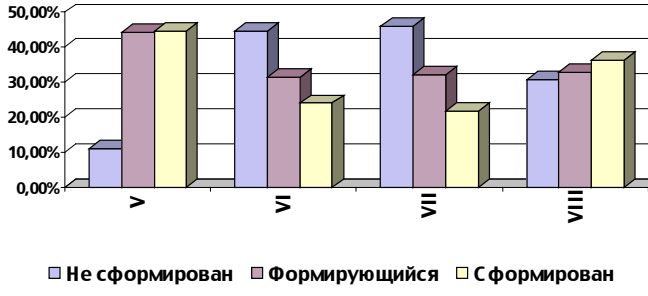

Fig. 2. Teachers' distribution diagram (%) according to the degree of formation of each of 4 symptoms (V–VIII) of the emotional burnout "resistance" phase

It follows from figure 2 that symptom V "Inadequate emotional reaction" is matured among 44,7 % and is forming among 44,2 %. A great number of teachers have matured symptom VIII "Reduction of professional duties" (among 36,41 %). There are similar results for VI and VII symptoms.

The first thing to note in the analysis of VSR frequency indices in the groups of surveyed teachers is that there is a considerable excess of standard values for all the absolute values of frequency characteristics of VSR by 1,5–3 times. Other authors have

already obtained similar results for inhabitants of the territory of Yugra [5]. Our own comparative analysis of the obtained data on VSR frequency indices with results obtained in other territories of the Russian Federation (Omsk, Arkhangelsk, Samara) has shown such considerable excesses of norms among inhabitants of Khanty-Mansi Autonomous Area. It give grounds for to assumption that specific climate-geographical features of the territory cause tension of all the functional systems.

The statistical significance of distinctions of dispersion of values of parameters of frequency characteristics of the heart rate variability in groups of teachers with immature, forming and matured symptoms of the resistance phase was estimated by results of the discriminant analysis.

For the frequency indices characterizing symptom V "Inadequate emotional reaction" the value of Wilks' lambda (λw) has made 0,93 (approximate F = 1,79 with $p < 0,08$), for the frequency indices characterizing symptom VI Emotional and moral disorientation", the value of Wilks' lambda (λw) has made 0,91 (approximate F = 2,59 with $p < 0,012$), for the frequency indices characterizing the VII symptom "Expansion of the sphere of economy of emotions", the value of Wilks' lambda (λw) has made 0,93 (approximate F = 1,89 with $p < 0,06$), which enables us to speak about nonrandomness of distinctions in distribution of the frequency indices on these three symptoms.

For frequency indices characterizing symptom VIII "Reduction of professional duties" the value of Wilks' lambda (λw) has made 0,93 (approximate F = 1,55 with $p < 0,14$) which we can interpret as a tendency to the nonrandomness of distinctions in distribution.

Considering average values of frequency characteristics of the heart rate variability ($\bar{x} \pm m_x$) in groups of teachers with different degrees of formation of 4 symptoms of the "resistance" phase there is the following regularity (tab. 1).

All 4 indices (HF, LF, VLF, LF/HF) at the stage of the "maturity" phase exceed similar indices at the stage of "immaturity". At the stage of "maturity" LF and HF values are the greatest and ever more remote from standard values. And statistically significant distinctions of LF index are found in symptoms V and VIII between groups teachers with immatured and matured symptom (with $p < 0,05$), and also significant distinctions of the index of HF for symptom VII between groups of teachers at the stage of "immaturity" and "maturity" of the symptom (with $p < 0,01$). The stage of "formation" is characterized in some cases by increasing the value (HF, LF, VLF and LF/HF), in other cases by decreasing. It testifies to the effect that when the phase is immatured there is a better general body state. Further at the stage of "maturity" there is a very unstable state; there is a certain "system shaking" when searching a new "stable" state under new conditions.

The VLF index behaves differently depending on a symptom. When symptom V – "Inadequate emotional response" – is developed at the "formation" stage values of this frequency characteristic considerably increase (from 2265,54 to 4067,71 ms^2/Hz with

p < 0,05), and when this symptom is forming there is a VLF value reduction, but it is not statistically significant. Since a number of authors [7] consider that VLF reflects psychoemotional tension, we assume that such a difference of value can testify to the effect that at the stage of "formation" of this symptom there is an increase of emotional tension and the nature of this tension can occur, in particular, from the intra personal conflict in connection with rejection of own unexpected emotional reactions.

Table 1

Average values of frequency characteristics (ms ^{2}/Hz) of the heart rate variability ($\bar{x}\pm m_x$) in groups of teachers with different degrees of formation of 4 symptoms of the "resistance" phase of the emotional burnout syndrome

Symptoms and the degree of development		VLF	LF	HF	LF/HF
V	A (n=24)	2265,54 ± 380,17*	1921,83 ± 333,35#	1363,13 ± 223,43	2,00 ± 0,31#
	B (n=96)	4067,71 ± 578,28	2975,52 ± 349,76	1649,18 ± 243,33	2,69 ± 0,25
	C (n=97)	3478,31 ± 519,11	3287,14 ± 425,56	1935,51 ± 438,88	3,10 ± 0,43
VI	A (n=97)	3398,07 ± 452,79#	2639,40 ± 326,82	1445,54 ± 263,84	2,68 ± 0,37*
	B (n=68)	3004,35 ± 568,28"	3047,65 ± 598,18	1792,31 ± 399,93	3,33 ± 0,38""
	C (n=52)	4776,15 ± 679,93	3603,17 ± 509,44	2243,96 ± 400,30	2,31 ± 0,30
VII	A(n=100)	3495,99 ± 597,87	2815,65 ± 355,31	1333,24 ± 196,72##	2,79 ± 0,35
	B (n=47)	3347,77 ± 480,36	2930,72 ± 449,87	1459,26 ± 272,01	3,45 ± 0,54""
	C (n=70)	3933,21 ± 599,68	3304,54 ± 571,62	2526,73 ± 497,78	2,37 ± 0,38
VIII	A(n=67)	3213,40 ± 464,94	2483,46 ± 336,41#	1527,09 ± 232,35	2,55 ± 0,35#
	B (n=71)	3640,30 ± 459,88	2952,34 ± 423,55	1831,89 ± 325,72	2,51 ± 0,38"
	C (n=79)	3905,19 ± 539,82	3476,19 ± 519,34	1853,18 ± 328,30	3,26 ± 0,41

Notes: V – "Inadequate emotional reaction"; VI – "Emotional and moral disorientation"; VII – "Expansion of the sphere of economy of emotions"; VIII – "Reduction of professional duties"; VLF (power of the super low-frequency component), LF (power of the low-frequency component of the range), HF (power of the high-frequency component of the range), LF/HF (index of the vagosympathetic interaction); the degree of matureness of a symptom: A – immatured, B – forming, C – matured, n – the number of persons. Significant distinctions by Fischer's criterion: * (#,») – p<0,05, ** (##,»») – p<0,01; conventional sign * – when comparing groups with the immatured and forming symptom; conventional sign # – when comparing groups with the immatured and matured symptom; «– when comparing groups with the forming and matured symptom.

When forming symptom VI – "Emotional-moral disorientation" VLF values reliably significantly increase from the "immatured" stage to the "matured" stage (with p < 0,05) and from the "formation" stage to the "formation" stage (with p < 0,05).

The results of the index of vagosympathetic interaction (LF/HF) are of greatest interest, since for this index reliably significant distinctions are obtained for each symptom. Figure 3 shows average values of the vagosympathetic index.

Notes: V – "inadequate emotional reaction", VI – "emotional-moral disorientation", VII – "expansion of the sphere of economy of emotions", VIII – "reduction of professional duties"; symptom stage: A – immatured, B – forming, C – matured, n – the number of persons

Fig. 3. The diagram of average values of the index of vagosympathetic interaction (LF/HF) in groups of teachers with different degrees of maturity of 4 symptoms of the "resistance" phase

As is known from the dynamics of changing the ratio of LF/HF it is possible to control how much time it will take for an organism to switch over to a "rest mode". Some similarity of the dynamics of symptoms V and VIII, and also similarity of the dynamics of symptoms VI and VII is observed. It is possible to assume that formation of symptoms V and VIII is accompanied by increasing domination of the VNS sympathetic department, and when forming symptoms VII the index of vagosympathetic interaction (LF/HF) reflects more unstable and intense state of an organism of teachers in the group with a forming symptom which means more expressed physiological reactions at the formation stage.

Conclusion

Symptoms of the "resistance" phase are most expressed among teachers-respondents. It was established absolute values of frequency characteristics are 1,5–3 times higher than standard values, that is connected with adaptive mechanisms of an organism when living in the territory of Yugra. Absolute values of frequency indices of HF, LF, VLF and LF/HF at the stage of "maturity" of each symptom of the "resistance" phase are higher than similar indices at the stage of "immaturity". The frequency index of VLF changes when forming all symptoms of the "resistance" phase, however authentically significant results were obtained only on (in) symptom V – "Inadequate emotional reaction" and symptom VI – "Emotional-moral disorientation". The index of LF/HF can be considered as a marker for assessment of development of symptoms of the "resistance" phase, since the obtained distinctions are reliably significant for each symptom (with $p < 0,01$ and with $p < 0,05$ depending on a symptom).

References

1. Boyko V. V. *Jenergija jemocij* [The energy of emotions]. St. Petersburg, Piter Publ., 2004. 474 p.
2. Vorobyeva E. V. *Intellekt i motivacija dostizhenija: psihofiziologicheskie i psihogeneticheskie prediktory. Diss. dokt. psikh. nauk* [Intelligence and motivation of achievement: psychophysiological and psychogenetic predictors. Dr. psych. sci. diss]. Rostov-on-Don, 2007.
3. Vorobyeva E. V. *Psihogenetika obshhih sposobnostej* [Psychogenetics of general abilities]. Rostov-on-Don, Southern Federal University Publ., 2011. 222 p.
4. Gnezdilova O. N. *Innovacionnaja pedagogicheskaja dejatel'nost' kak faktor preduprezhdenija jemocional'nogo vygoranija uchitelja. Diss. cand. psikh. nauk* [Innovative pedagogical activity as a factor of prevention of the teacher's emotional burnout. Cand. psych. sci. diss]. Moscow, 2005.
5. Eskov V. M., Filatova O. E. Maystrenko E. V., etc. Metody issledovanija stepeni sinergizma v funkcional'nyh sistemah organizma cheloveka prozhivajushhego na Severe [Methods of research of the degree of synergism in functional systems of the organism of a person who lives in the northliving in the north]. *Materialy nauchno-prakticheskoj konferencii «Jekologicheskie problemy i zdorov'e naselenija na Severe»* [Proc. the Scientific-Practical conference "Environmental Problems and Health of Population in the North]. Surgut: Surgut State University Publ., 2004, pp. 106–111.
6. Kiroy V. N., Ermakov P. N. *Kratkij kurs fiziologii vysshej nervnoj dejatel'nosti i sensornyh sistem* [Short course in the physiology of the higher nervous activity and sensory systems]. Rostov-on-Don, 2004.
7. Kudrya O. N. Osobennosti srochnoj adaptacii serdechno-sosudistoj sistemy sportsmenov s razlichnym ishodnym vegetativnym tonusom pri ortostaticheskom testirovanii [Features of urgent adaptation of the cardiovascular system of athletes with various initial vegetative tone at orthostatic testing]. *Vestnik Tomskogo gosudarstvennogo pedagogicheskogo universiteta – Tomsk State Pedagogical University Bulletin*, 2011, no. 5, pp. 55–61.
8. Kurapova I. A. Sistema otnoshenij v professional'noj dejatel'nosti i jemocional'noe vygoranie pedagogov [The system of relations in professional activity and emotional burnout of teachers]. *Psihologicheskij zhurnal – Psychological Journal*, 2009, V. 30, no. 3, pp. 84–95.
9. Mamiy B. I. Spektral'nyj analiz i interpretacija spektral'nyh sostavljajushhih kolebanij ritma serdca [Spectral analysis and interpretation of spectral components of a heart rate oscillations]. *Fiziologija cheloveka – Human Physiology*, 2006, V. 32, no. 2, pp. 52–60.
10. Nenart E. O. Vzaimosvjaz' sindroma jemocional'nogo vygoranija s jelementami professional'noj deformacii lichnosti uchitelja [Interrelation of the emotional burnout syndrome with elements of professional deformation of the teacher's personality]. *Vestnik Sankt-Peterburgskogo universiteta – St. Petersburg University Bulletin,* Series 12: Psychology. Sociology. Pedagogics, 2008, no. 3, pp. 402–406.

11. Orel V. E. *Sindrom vygoranija v sovremennoj psihologii: sostojanie, problemy, perspektivy. Sovremennye problemy issledovanija sindroma vygoranija u specialistov kommunikativnyh professij: kollektivnaja monografija* [The burnout syndrome in modern psychology: state, problems, prospects. Modern problems of research of the burnout syndrome among experts of communicative professions: the collective monograph]. Kursk, Kursk State University Publ., 2008, pp. 54–80.
12. Revina N. E. Kotov A. V. Sindrom «Burnout» i spektral'nye pokazateli variabel'nosti serdechnogo ritma ["Burnout" syndrome and spectral indices of a heart rate variability]. *Vestnik Novgorodskogo gosudarstvennogo universiteta im. Jaroslava Mudrogo – The Yaroslav-the-Wise Novgorod State University Bulletin,* 2010, no. 59, pp. 29–32.
13. Leiter M. P., Maslach C. Banishing burnout: six strategies for improving your relationship with work – Jossey-Bass, A Wiley Imprint, 2005. – 193 p.
14. Maslach C. *M.* Job burnout: new directions in research and intervention // Current Directions in Psychological Science. – 2003. – Vol. 12. – P. 189–192.