

Mathematical modeling of the phenomenon of organizational stress in athletes using mathematical regressions

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Abstract: *The main objective of this work is to measure the level of organizational stress existing in a sports organization, and as an extension the theoretical objective: diagnose this organization from this perspective, having as diagnostic tool the organizational stress index, to further establish measures imposed, as well as the nature of these measures.*

A secondary objective, of a practical nature, is the identification of stressors that act more aggressively, in order to be a useful tool and other sports organizations, which face more or less similar problems and which, without launching a study that requires time and financial resources, could use the conclusions and quickly apply remedial measures.

Keywords: *organizational stress, sports stressor, mathematical regressions*

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I. Introduction:

The main hypothesis is: employees of a sports organizational entity experience high levels of organizational stress due to the cumulative action of several stressors - individual, group, intergroup and organizational nature, illustrated by a stress index greater than 2.5 according to the INCPDM method

Another hypothesis is that the employees of the sports organization feel stress differently, depending on the freedom to decide on some aspects of the place of activity (professional categories - decision makers and performers).

Another working hypothesis is the possibility to mathematically model the data collected from the field through the O.S.I. with the help of the laws of variation expressed by mathematical regressions; in the alternative, the higher the degree of regression, the higher its confidence factor and the graph generated by this law is as accurate as possible or absolutely faithful to the maximum confidence factor ($R = 1$).

Study material :

The research area includes the entire active population of a sports organizational entity, ie 334 employees, of which 77 management factors. The questionnaires were completed correctly and in full by 52 leading employees and 102 executive staff. The rest of the questionnaires were not taken into account, being partially completed or completed without demographic data, so statistically invalid. This is a shortcoming of self-applied sociological questionnaires.

Working method

The working method is not the usual statistical one. It is preferred to analyze the data using the I.N.C.P.D.M. and for this, organizational stress is declared as a risk variable. The principle of the method consists in creating, as working support, functional matrices of type $\mathbb{F}(m, n)$, where m = number of rows (valid

interviewees), and n = number of columns (number of items). With the help of the XY Scatter functions from Excell, the trendline package, regression laws, different variation laws are obtained. The Organizational Stress Inventory Questionnaire was used as a data collection tool. It includes a battery of 7 socio-psychological tests, each with a certain number of items (questions / statements). After dividing the employees into two professional categories - performers / professions and decision makers - the O.S.I. questionnaire has been adapted according to their level of understanding and specificity. For professions The O.S.I. has 128 items in total, with easy item formulation. For the decision makers there are 132 items, the 4 additional ones regarding aspects of the management work and were added to chapter IV- Sources of voltage at work. In this paper we will address only the chapter of the OSI questionnaire, the first 12 items.

The questionnaires were adapted to the category of staff, in the case of decision makers 4 questions were added to Chapter 4 "Sources of voltage in your service", questions that address the specifics of management and do not find their usefulness in the questionnaires of executive staff. In the case of the respondents profession of execution, the wording of the items was adapted to an easy level of understanding. The questionnaires were applied when leaving for home after the end of the activity, whether it is about the decision makers or the execution staff, so some of the shortcomings due to not filling in some data can be attributed to fatigue.

The preliminary analysis of the data supports the hypothesis according to which, within the sports organizational entity, there are factors specific to organizational, group and individual stress, which positively correlate with one of the working hypotheses specified at the beginning.

Before the global assessment, the chapters (tests) of the questionnaire will be analyzed in turn. The test battery was considered as a single test with 129 items in the case of respondents generically called sports specialties (performance factors). In the analysis of each test (chapter) will be specified the number of items per test or how many items in the test is the analyzed item, as well as its position in the general framework of the questionnaire.

The first analysis will focus on the execution factors. The first chapter of the general questionnaire asks the respondents to answer the question "What do you think about your activity / service?". The chapter has 12 items.

The centralized data of Chapter I are presented by items in the grid below:

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12
Val 1	25	19	11	8	8	4	4	5	8	4	6	6
Val 2	41	52	35	34	23	39	38	17	46	46	29	55
Val 3	29	26	48	43	54	43	30	52	35	47	48	17
Val 4	4	3	6	15	12	14	25	24	11	4	15	20
Val 5	3	2	2	2	5	2	5	4	2	1	4	4

Table 1a. Chapter I. Data centralized by items. Sports specialties.

Summarizing the data in the grid above, for an overview of Chapter I we obtain the following table:

	Cap 1
val 1	108
val 2	455
val 3	472
val 4	153
val 5	36

Table 1b. Chapter I. The summed values of the 12 items

Where:

- 1 = a lot of satisfaction
- 2 = a lot of dissatisfaction
- 3 = neither satisfaction nor dissatisfaction
- 4 = a lot of satisfaction
- 5 = a lot of dissatisfaction

The data in the table are presented as a percentage value in fig. 1a:

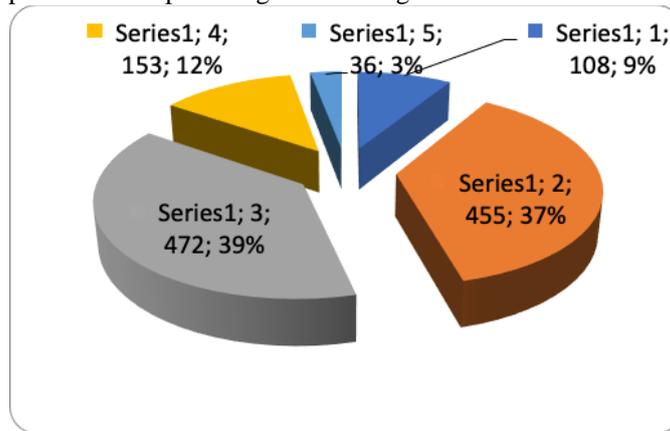


Figure 1a. Chapter I. What do you think about your Sports Specialties service?

The centralized data for Chapter I “What do you think about your service?”, collected from 102 respondents (the entire active population from the sports organizational entity, execution work, with valid questionnaires) show that most of the respondents are in the gray area, ie they feel neither satisfaction nor dissatisfaction (39%), as the final phase (apathy) of the installation of stress and it correlates positively with one of the research hypotheses. This aspect can draw attention to the fact that those concerned have ceased to be in the activity they have, they no longer act in the sense of improving the situation and finding a solution. There is a percentage of 17% of respondents who already experience high levels of dissatisfaction. They need more attention, because, together with those in the gray area, they accumulate over 50%. In general, the sports organizational entity is subject to organizational stress, a statement that correlates positively with the first working hypothesis of research. The item analysis of this chapter shows which stressors of the organization act mainly.

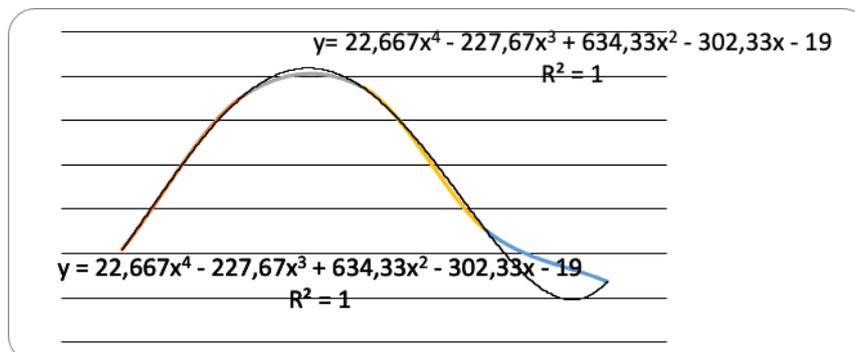


Figure2b. Chapter I. What do you think about your Sports Specialties service

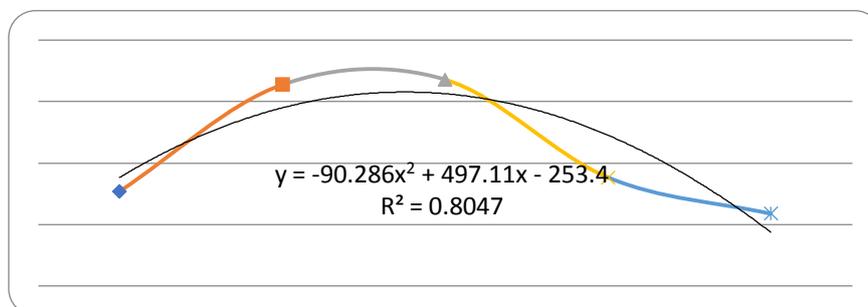


Figure2c. Chapter I. Graphic illustration of data. Sports specialties

Looking at the graph, it can be seen that there is a downward orientation, in the sense that from the maximum degree of job satisfaction (level 1 and 2) it goes down to levels of dissatisfaction (level 4 and 5), after there is a "gray" area , no satisfaction, no dissatisfaction. This presentation supports the conclusions drawn from the analysis of the answers by items.

On the graph in fig.2b and fig.2c, we notice the 2 laws of variation deduced with the help of polynomial regressions of order 4 and order 2. The one of order 4 having the confidence coefficient $R = 1$, is considered a law of faithful variation, almost absolutely. Instead, the graph of the law of variation deduced with the help of polynomial regression of order 2, although it has a coefficient $R = 0.8966$ (also very good) lower than the law of variation of order 4, shows us with great precision, maximum or maximum absolutely for the analyzed values.

The study of the graph of the law of variation deduced with the help of polynomial regression of order 4 shows us, by sections, the local maximum and minimum trends, the increase and decrease of values on the analyzed value areas, as well as the inflection points and positively correlate with the last research hypothesis.

Analyzing the workplace climate as a factor related to the organizational climate, we analyze item 10 "Psychological atmosphere or the existing climate at your place of activity". According to the respondents' answers, we have the following situation in percentage data:

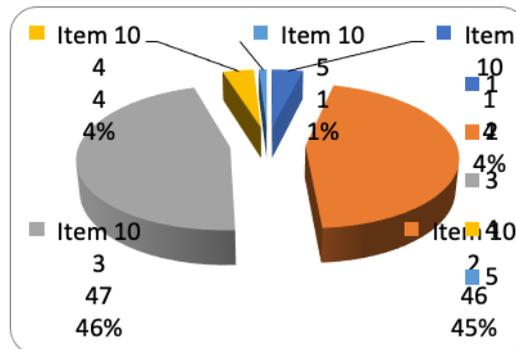


Figure3a. Chapter I. The psychological atmosphere or climate in the workplace. Sports specialties

The percentage of those satisfied with the psychological atmosphere and those who are indifferent is almost identical, with a percentage of 1% difference. The question arises what happens in this organization: the situation is related to the personality of athletes or are there favorable situations only for some of them, maintained by the organization. If so, the next question is to what extent this causes the demoralization of those in the "gray" area.

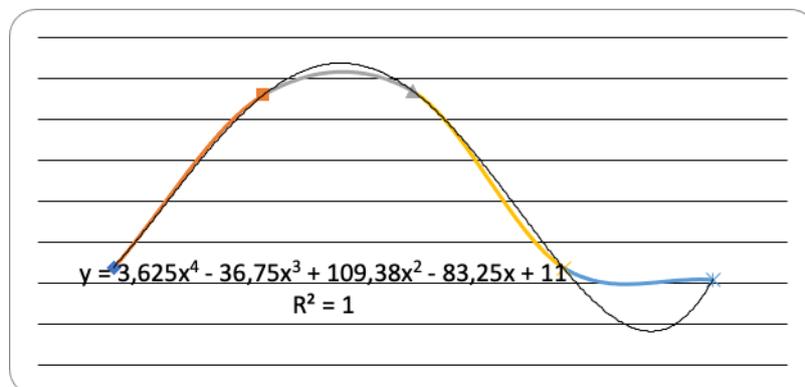


Figure3b. Chapter I. The psychological atmosphere or climate in the workplace. Sports specialties

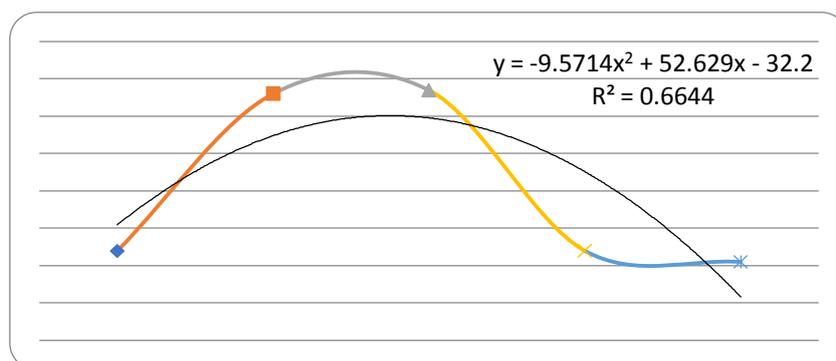


Figure3c. Chapter I. The psychological atmosphere or climate in the workplace.

From the graphical representations of the variation of the same item deduced by 2 distinct laws of variation: polynomial regression of order 4 in fig.3b and polynomial regression of order -the first variation law having the confidence coefficient $R = 1$, indicates a high fidelity variation, and the analysis of the convexity and concavity of the graph of that variation law, gives us the tendencies of increase and decrease of the analyzed value level, local maxima and minima.

- the second law of variation having the confidence coefficient $R = 0.8148$ (a good coefficient too) indicates the absolute maximum around 2.5 of the abscissa.

Both graphs place the absolute maximum point at $x_{Max} = 2.5$. This fact would support the statement that, from the point of view of the psychological atmosphere at work, there is no organizational stress, which is contradicted by reality. Either the respondents do not have the courage to tell the truth, for fear of the reaction of the management of the sports organization, or they still have a somewhat idealized perception, based on the feeling of cohesion and solidarity given by the organizational culture of sports specialties, one of the strongest and most cohesive organizational cultures from all areas of human activity.

According to the scale of assessment, it is observed that a number of 46 respondents (45%) appreciate that they feel satisfaction (they are satisfied) with the atmosphere at work, statements contradicted by reality. In this case, one can talk about the fear of repercussions from the management if they tell the truth. The financial component should not be neglected either, knowing that the salaries of those who work in certain sports specialties are much higher than those in other sectors. It is observed that there is a significant percentage of respondents (46%) who are in the gray area: they experience neither satisfaction nor dissatisfaction. For them, the financial component has somewhat diminished its attractiveness and reveals job dissatisfaction. Here it would be necessary to observe the factors that create dissatisfaction: poor development prospects at the place of activity, faulty relationships with hierarchs and / or colleagues, etc. These aspects can be found in the items of the other chapters of the questionnaire 2 in fig.3c, we notice the following consequences:

Item 4 of this chapter "The extent to which you feel stimulated by the current activity" is responsible for the lack of attractiveness of the current activity. 42% of respondents show a state of indifference that shows that they work mainly to meet their financial needs, either do not look for new incentives to the current job, or have given up doing so as this requires energy resources that do not they still have. This fact, correlated with a poor state of health and lack of resources for relaxation and leisure, with decreased personal energy for household chores, clearly indicates that respondents in the "gray" area are subject to stress in the last stage. Here they can act as factors such as overloading the role, as a result of the massive layoffs in the sports sector, which took place in previous years, the service tasks being redistributed to the remaining ones; organizational policies act here as stressors, with respondents being concerned that the next ones may be laid off, affecting both themselves and their families by diminishing income. As a percentage, the data collected look like this:

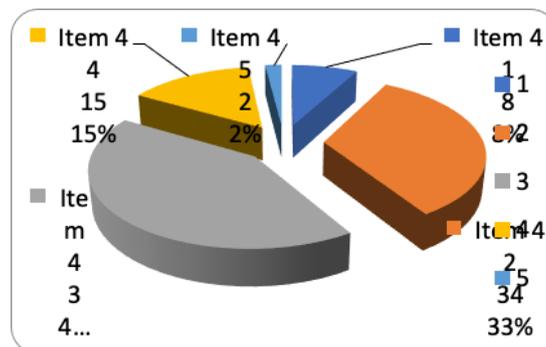


Figure4a. Chapter I. The extent to which you feel stimulated by the work you do. Sports specialties

The graphical rendering of the data, using as laws of variation the polynomial regression of degree 4, first, and that of degree 2, later, is presented as in fig.4b and fig.4c, also displaying the confidence coefficients R for each.

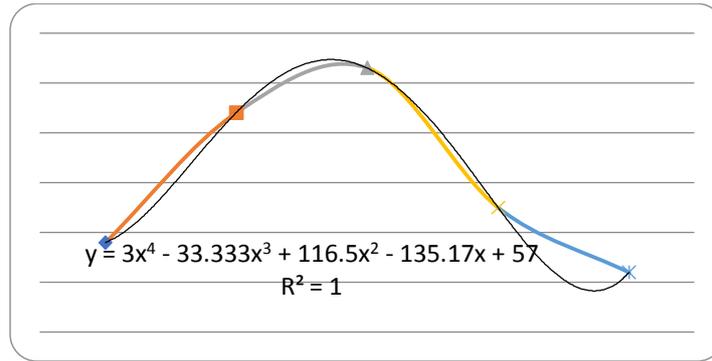


Figure4b.Chapter I. The extent to which you feel stimulated by the work you perform. Sports specialties

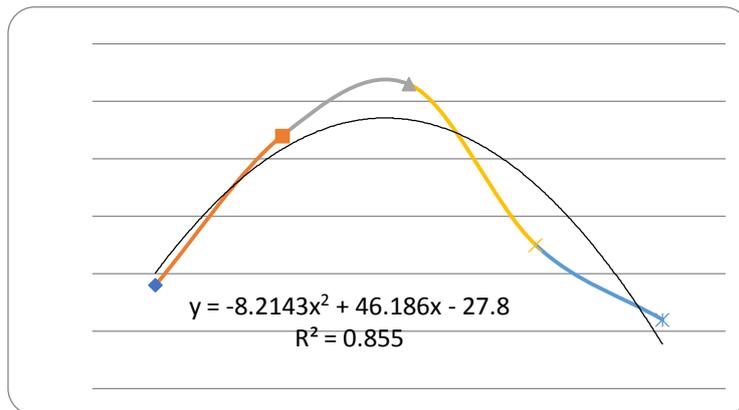


Figure 4b.Chapter I. The extent to which you feel stimulated by the work you perform. Sports specialties

Analyzing the graphical expressions, the one in fig.4b places the absolute maximum point around the value of $x_{Max} = 2.5$ on the abscissa, ie close to the “gray” area, suggesting that there would be no dissatisfaction. The confidence factor is maximum in the first case (that of using the polynomial regression of degree 4 as the law of variation), ie $R = 1$, so the graph is absolutely faithful. In the case of the graph presented in fig.4c, the absolute maximum point is located around $x_{Max} = 3$ on the abscissa, ie in the “gray” area, that of expressing the final stage of organizational stress. The use of polynomial regression of degree 2 as a law of variation has a confidence factor $R = 0.9407$ which is a very good coefficient, in the absence of the maximum.

Among the items analyzed in previous published papers, item 12 asks respondents to appreciate the extent to which they feel involved in the current service. Although a significant percentage of respondents responded that they feel involved in their service, this attitude is part of a defense mechanism by avoiding conflict and presenting an idealized situation, the overall situation proving completely different. The stressor acting in this case is related to the nature of the entity of the sports organization, a statement that correlates positively with one of the working hypotheses of research. The percentage expression of the data collected for this item is presented in fig.5a:

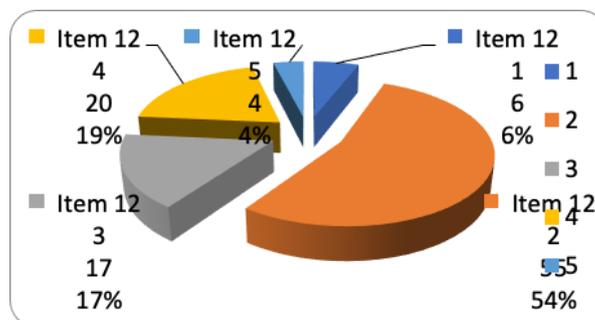


Figure5a. Chapter I. The extent to which you feel involved in your service Professions

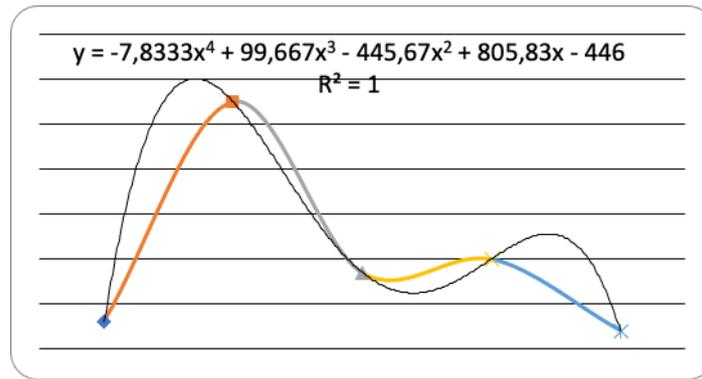


Figure5b.Chapter I. The extent to which you feel involved in your work. Sports specialties

Looking at the graph in Fig. 4b and the percentage rendering of the data in Fig. 5a, it is observed that a percentage of 60% (cumulative values 1 and 2 of the assessment scale) consider themselves involved in the work they perform and, nevertheless, according to their responses to item 4 of this chapter "The extent to which you feel stimulated by the activity you perform", these respondents do not feel stimulated by their activity-sports specialty. The somewhat contradictory answers reinforce the belief that the respondents tried to present ideally the existing situation at the place of activity, the desire being greater because these questions are located at the beginning of the questionnaire, when the idealized image could be maintained more easily. This fact correlates positively with one of the working hypotheses, the one regarding the idealized presentation of the situations, as a defense mechanism.

Analyzing the graphical representation, which has the maximum confidence coefficient $R = 1$, we notice the absolute maximum point $x_{Max} = 1.5$, followed by a local minimum in $x_{min} = 3.5$ which is also the inversion point for graphical growth to a local maximum in $x_{max} = 4.5$. Translated into words, after experiencing the feeling of satisfaction ($x = 1.5$ on the abscissa) the trend is downward to the state of indifference, experienced by few respondents, and then to experience an upward return to $x = 4.5$ as a state of dissatisfaction experienced by some respondents.

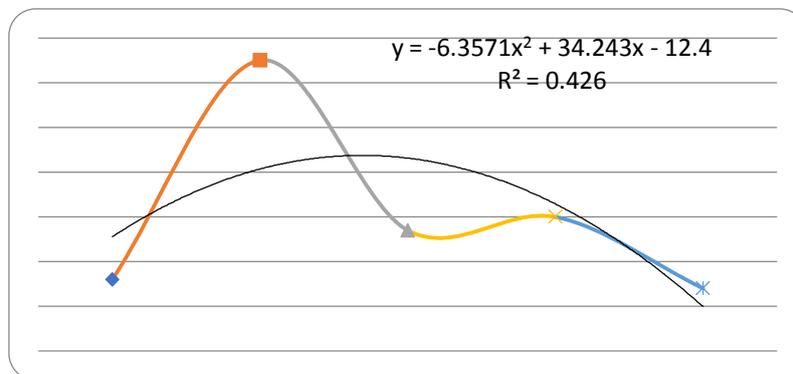


Figure5c.Chapter I. The extent to which you feel involved in your work. Sports specialties

Looking at the graph in fig.5c, we can notice its flattened curve, compared to the one in the graph in fig.5b. This graph, as a result of the use of the law of variation given by the polynomial regression of degree 2 has a quite small confidence coefficient $R = 0.6526$, compared to the one given by the use of the law of variation expressed by polynomial regression of degree 4 which is $R = 1$. The graph in fig.4c reduces the local and absolute maximum and minimum elements to an absolute maximum at the point $x = 2.5$ which consistently changes the perception of the studied phenomenon.

If the index of organizational stress resulting from the data of chapter I is calculated, we have the following, according to the I.N.C.P.D.M method:

$$OSI_{rg} = \frac{\sum_{i=1}^{129} r_i \cdot R_{im}}{\sum_{i=1}^{129} r_i}$$

Where:

OSIrg - indicator of general occupational stress (calculated by category of professions)

Rim - the average occupational stress level per organization, takes values from 1 to 5

ri - frequency of stress level

i - the number of items from the 7 questionnaires, takes values from 1 to 129

$OSI_{capl} = 108 \times 1 \times 1 + 455 \times 2 \times 2 + 472 \times 3 \times 3 + 153 \times 4 \times 4 + 36 \times 5 \times 5$

$$\frac{108 \times 1 + 455 \times 2 + 472 \times 3 + 153 \times 4 + 36 \times 5}{108 + 1820 + 4248 + 2448 + 900} = \frac{9524}{3226} = 2,952$$

The value obtained is above the average of 2.5 accepted as a tolerable limit, above which there are signs of organizational stress. Of course, organizational stress will always be present in organizations, it is a factor inherent in their functioning. It depends on the managerial attitude, first of all, on the set of sports, social and economic conditions that act in the society at that time, it depends on all these factors that the level of organizational stress exceeds the levels of danger for the specific sports organizational entity and also for the people that form these structures.

II. Conclusions, personal contributions

Conclusions

A first conclusion that emerges at the end of the study is that the employees of the sports organizational entity are subject to high values of organizational, group and individual stress. This stress is generated both by the specific working conditions in sports activity, and especially by the special problems that this sector has been facing for several decades.

Analyzing the large number of answers that are located in the middle zone (value 3) the conclusion that is required is that there are mostly athletes who have been working for a long time in this branch of activity and a state of indifferent acceptance of things, apathy. The fact that they have a long history in the current position has a positive aspect, if we take into account the qualification and sports experience required in the field. But at the same time it has a big disadvantage: the installation of the routine state, indifference, apathy. This state predisposes to lack of reaction, appropriate and timely, not only in the field of group relations (organizational, intergroup) and personal, but also in the speed with which decisions are made in tense moments in the process of activity. A low reaction speed predisposes to incidents at the activity place, with material and health costs of those involved, leading to serious accidents, with significant effects on large groups of athletes and significant human losses. Such accidents occur quite often.

Following the analysis of the data provided by the field research, all three working hypotheses of the study are confirmed:

- employees of the sports organizational entity experience high levels of organizational stress due to the cumulative action of several stressors - individual, group, intergroup and organizational, illustrated by a stress index greater than 2.5 according to the I.N.C.P.D.M. ;
- the employees of the sports organizational entity feel stress differently, depending on the freedom to decide on some aspects of the place of activity (professional categories - decision makers and performers);
- the possibility to mathematically model the data collected from the field through the O.S.I. with the help of the laws of variation expressed by mathematical regressions; in the alternative, the higher the degree of regression, the higher its confidence factor and the graph generated by this law is as accurate as possible or absolutely faithful to the maximum confidence factor ($R = 1$).

6.2. Personal contributions

The personal contribution to this study is the way the data is processed. Using the I.N.C.P.D.M. which allows the mathematical quantification of the level of organizational stress as a risk factor. According to the assessment scale of the test battery, from 1 to 5, it is estimated that up to half is the level of eustress, that beneficial component of organizational stress. Any value over 2.5 obtained with the given mathematical relationship is considered alarming and requires intervention. The higher the index, between 2.5 and 5, the more severely affected the organization is. Intervention measures are required as quickly as possible, according to OSH rules.

Another personal contribution is the mathematical modeling of the phenomenon of organizational stress using variational calculus. The obtained graphs are not continuous functions, but are step functions with distinct values. In this case the polynomial regression laws become interpolation polynomials. And yet, the human being is not discontinuous in its emotional functioning, so variational regressions remain valid as a method. The human scale of appreciation of any aspect of life has no steps, but presents itself as a continuum between extremes. So the fractional values of the graphs can very well describe the reality of the person's internal feelings, of the miners participating in this study.

The abandonment of standard methods of statistical analysis does not imply less scientific rigor. The methods used in engineering can also be successfully applied to the social sciences, such as psychology. The amount of data processed in this way is still modest, further studies are needed to process the data in this way, in order to be able to generalize and conclude at the level of micro- and macro-organizations. This is a limitation of this study. The general legitimacies that can be obtained as conclusions of these processes must be rigorously documented and based on multiple researches, in order to be taken into account.

Recommendation

It is obvious that in sports there are many internal and / or external factors that contribute to raising the level of stress, in all periods of training, from the preparatory to the competitive. The contributions brought by the specialists in the field of sports psychology come to blur this negative aspect of the life of any athlete and any sports organization. We recommend that the sports psychologist be introduced in the life of any athlete, team and sports organization, as he can make a decisive contribution to achieving clearly superior performance both in competition and in their daily lives.

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