

CONTRIBUTIONS TO THE ESTABLISHMENT OF RELEVANT INDICATORS TO DIVIDE THE LEARNING PROCESS IN THE CONTEXT OF EXERCISE AT THE FEMALE PERFORMANCE HANDBALL TEAM

Marinică Iacov PÂRVĂNESCU*

„Cetate” National Sports College, Deva , Hunedoara County,
marinicapi@yahoo.com.

Abstract: The experimental research starts from the premise that only by using a performance recording devices can determine the exact value of relevant indicators.

Experimental research objectives: identifying relevant indicators that underline the learning process; emphasizing the key role of the heart rate in directing the effort in the training lesson in the female handball game; identification of specific handball team effort in the training lesson compared with specific exercise areas in monitored matches; setting relevant comparisons according to the position in the team; setting max VO₂ values; confirmation of the working hypotheses by statistical and mathematical processing of the relevant indicators identified by experiment and establishing the minimum reference models in the team and individual player based on the percentage values after the recordings made for the heart rate and the calorie consumption.

The inductive hypothesis refers to the efficient use of the relevant indicators, measured with modern electronics, in the preparation of the players of the performance handball to increase the exercise capacity.

The deductive assumptions are:

- If we monitor and operate with relevant indicators, measured with special applied electronics, we might succeed the optimization of the high performance training of the handball game.
- If we set during the training session the exact value of some indicators such as the heart rate and the calorie consumption and we differentiate the habitat areas of effort, then we might improve the exercise capacity.
- If we divide the training process using our tactical and technical structures of the handball game, rationalized on the basis of the measured values of the relevant indicators, then it might influence the exercise capacity and the motor exercise that may be at a higher level in the competition.

During the experiment the following relevant indicators confirmed the research hypothesis: energy consumption per minute; resting heart rate; average heart rate; supramaximal and maximal effort; submaximal effort; moderate effort and aerobic effort. The relevant indicators which have not confirmed the hypothesis of the research are: total energy consumption, total number of pulses and the maximum heart rate.

* Marinică Iacov Pârvănescu

The experimental studies emphasize-through the results – the necessity to use for trainings the proper equipment to provide the significant physiological information to the coach and the player alike.

From the measurements made during the research we found out that the percentage of working with a certain intensity value given by the heart rate and the players is:

- 13.2 % for the pivot player- a participation to achieve the effort having maximum frequency
- 35.8% for the left wing player- a participation to achieve the effort having submaximum frequency
- 30.5 % for inside player- a participation to achieve the effort having a moderate heart rate

The participation percentage of energy resources - to achieve the efforts specific to the female handball game:

- 12% for maximal and supramaximal efforts- anaerobic-alactacide compared with 20%-value offered by specialists
- 34% for submaximal efforts- anaerobic-alactacide compared with 30%-mentioned by specialists
- 23% for mixed efforts
- 31% for anaerobic efforts compared with 50%-mentioned by specialists

Using equipment for recording the heart rate in real effort conditions may represent a valuable evidence of activity performed during the competitive year.

Key words: indicator, relevant, divide, exercise, learning process, team game, handball, sports performance

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INTRODUCTION “Synthesis and culmination of life on earth”¹, man” is a living system, hipercomplex, endowed with body and spirit”², whose psychosocial and biological evolution is facilitated, synergistically, through: movement, attitude, behaviour-all being under the sign of aspiration to an ideal sphere that can be dressed in the tangible form of polysemous performance - in various fields-the broad realm echo enjoying hugely popular sport.

The polysemy notion of sports performance, reflected in the complexity of psycho-motor activity is identifiable, from our point of view, at the time, both in terms of the two coordinated likely to be segmented: diachronic division (T1, T2, ... Tn- diachronic split-phase accumulation: training) and synchronic division (T1 sau T2- split-ends synchronic : sports competitions), and the vision of establishing relevant indicators, both aspects being integrated- complementary- to a training process in the context of exercise. This training process envisages comprehensive strategy (related to sports steering) to exploit human resources (skills, attitudes, motor qualities), an important role being assumed to the workouts, approachable interdisciplinary, beneficial to the leading sportsman’s personality -as entity or as a social link (team)-in sports competitions.

EXPERIMENTAL RESEARCH The purpose of this research is to identify, through a performance recording device, relevant indicators underlying the learning process and on which this can be divided into the context of the specific training effort in a handball team from the National League.

RESEARCH HYPOTHESES

1. If you monitor and operate with relevant indicators, measured with special applied electronics, we can optimize the training of high performance in the handball game.

¹ Vitalie Belous, Traian Stanculescu , Horia Teodorescu , Octavian Ungureanu, *Performantica sportiva, om, miscare, sport si dezvoltare sociala* in PERFORMANTICA. Interferente. Sinergii. Confluente, Editura PERFORMANTICA, Iasi, 1996, p.197

² Id. ibid

2. If during the training we set the value of some indicators such as the heart rate and the calorie consumption and we differentiate the habitat areas, then we can improve the exercise capacity.

3. If we divide the training process using our tactical and technical structures of the handball game, rationalized on the basis of relevant indicators measured values, then we can influence the exercise capacity, and the motor expression may be at a higher level in the competition.

4. If there is a statistically significant correlation between the variables supported by the records lengthwise and the transverse analysis of the phenomenon, then the exercise capacity can be optimized.

5. By obtaining accurate values of relevant indicators and finding a record of their synergistically manifestations, then the effects should be significant with regard to the increase of the exercise capacity of high performance female handball.

EXPERIMENTAL RESEARCH VARIABLES

1. The dependent variable is represented by the values of heart rate which may be modified by the effort specific to the handball game. By the heart rate values depends the oxygen consumption value in the unit time.
2. The independent variable is represented by the specific performing effort of the female handball game using tactical and technical structures divided into attack and defense, each time on the phases separately and depending on the content elements of sports training. Anticipating that by using the chosen technical-tactical structures there will be a positive influence in relation to the optimization of the physiological exercise capacity.

ADEQUACY OF THE METHODS AND TECHNIQUES APPLIED IN ACTUAL RESEARCH

The methods used during the undertaken research are: the scientifically documentation, the pedagogical method of observation, the questionnaire method, the statistical methods, the pedagogical experiment method, the recording method, the logical method, the graphical method. Apart from these methods we shall do some considerations on the recording method:

The recording method is a symbiosis between modern and empiric designed to capture the concrete reality of the motric expressions of the female players of handball, depending on the position in the team, training, and competing. By means of an advanced electronic device The Team Polar System we have highlighted the relevant indicator: the heartbeat (figure 1).

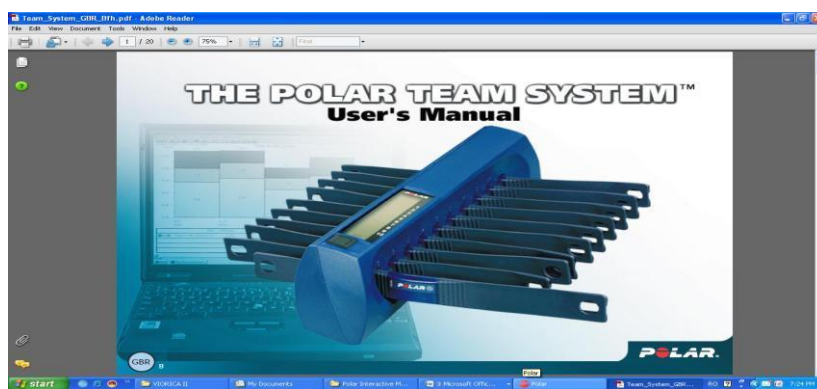


Figure 1. The Team Polar System used for recordings during the experiment undertaken to the CSM CETATE Devatrans team from the National Female Handball League

The records are unequivocal; they highlight the physically effort involved in the training or match of the player and can be stored in this form by being able to perform comparisons on exercise capacity evolution and its implications on performance capacity.

When the necessary interpretations were made after recording with the Team Polar System on the CSM CETATE Devatrans team we also used the existing specifications from the User's Manual. These specifications refer to four fundamental benchmarks for objective assessment of physical effort: the zonal trend, the relative intensity of the effort to the maximum heart rate during the performed exercise and the effects that this type of effort has a stress on the body (table 1).

Table 1. Indicative benchmarks for reporting information obtained from records using the Team Polar System

Tendință zonală (Target zone)	Intensitate procentuală (Intensity % Of HRmax)	Durata efortului (Example durations)	Beneficii fiziologice/ Efectele antrenamentului (Physiological benefit/ Training effect)
Maxim (Maximum)	90-100%	sub 5 min.	Creșterea vitezei de sprint/ Obositor pentru respirație și mușchi
Greu (Hard)	80-90%	2-10 min.	Creșterea capacității maxime de performanță/ Obosală musculară și respirație greoaie
Moderat (Moderate)	70-80%	10-40 min.	Îmbunătățește fitness-ul aerob/ Obosală ușoară a mușchilor, respirație ușoară, transpirație moderată
Ușor (Light)	60-70%	40-80 min.	Îmbunătățește rezistența, ajută recuperarea/ Respirație ușoară, confortabilă, transpirație ușoară
Foarte ușor (Very Light)	50-60%	20-40 min.	Îmbunătățește sănătatea și metabolismul/ Efectele sunt foarte mici pentru toate funcțiile corpului

ASSESSMENT OF RELEVANT INDICATORS DURING THE EXPERIMENT

The establish energy consumption patterns and areas of female handball specific effort depending on the post

Based on data collected, the average percentage was calculated for recordings made during the training lessons for getting the model value of the relevant indicator on each position to play in the team, which we present as following:

The model of the energetic consumption per minute in relation to the time of the trening session

Postul ocupat	Es	Is	Cj	Piv	Id	E	P	Postul ocupat	Es	Is	Cj	Piv	Id	Ed	P
Consum energetic/min	5,3	5,7	4,0	5,5	4,0	3,8	4,7	Consum energetic total	451	505	315	496	369	357	401

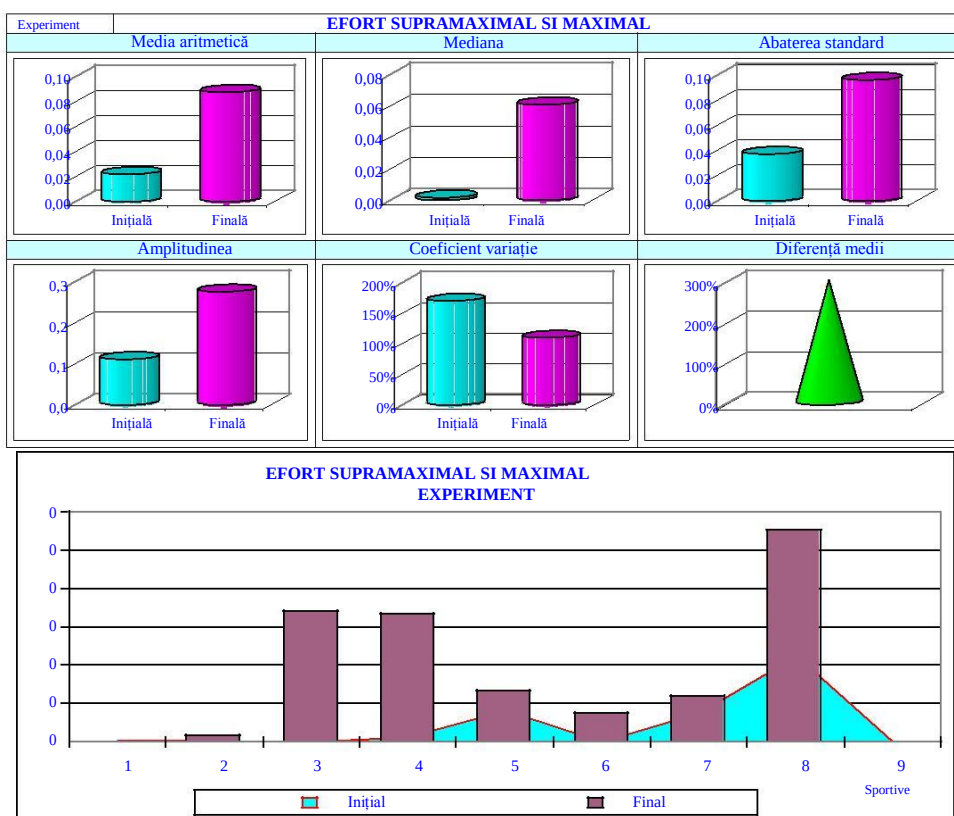
The model of the total energetic consumption in relation to the time of the trening session

The model of total energetic consumption during the game

The percentage model of maximal h.r. during thge trening session

Postul ocupat	Es	Is	Cj	Piv	Id	Ed	P	Postul ocupat	Es	Is	Cj	Piv	Id	Ed	P
Consum energetic total	374	792	396	395	623	355	262	Frecvența Cardiacă	9	5	9,4	13,2	9,2	5,0	0,4

Contributions to the establishment of relevant indicators to divide the learning process in the 43 context of exercise at the female performance handball team



COMPARATIVE ELEMENTS OF SYNCHRONISM BETWEEN HEART RATE, EXERCISE AREAS AND ENERGY CONSUMPTION –SPECIFIC TO THE HANDBALL GAME

We further present two reference images for the analysis we have made on the basis of the recordings.

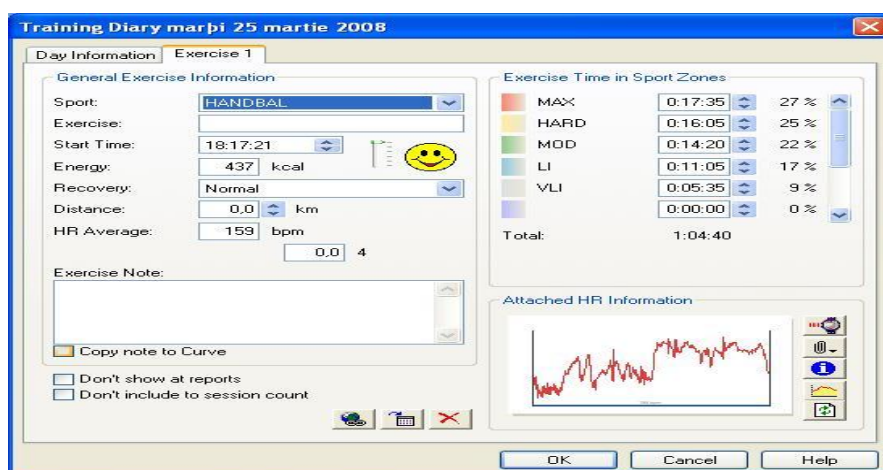


Figure 2. Specific competitive effort in the female handball game

In Figure 2 we have a picture of the route blocker heart rate and the effort distribution areas (top right image), recording made in the test match held by the team Cetate Ddevatrans in the company of the team U. Jolidon Cluj Napoca.

The alternation of the heart rate during the training lessons differs substantially from the plateau of the heart rate recorded during school games or especially during the test games held in with the same company echelon teams. Recordings of the handball players in different classes with different content and level of effort were made each time using as reference the analysis made as plateau values of the heart rate from the recorded match (this recording is unique considering the fact that by the nature of this game the belts can be removed during technical-tactical actions, and the official rules forbid the use during matches of any object that may cause injury in certain game situations to the player involved in our approach recording of relevant indicators of the exercise).

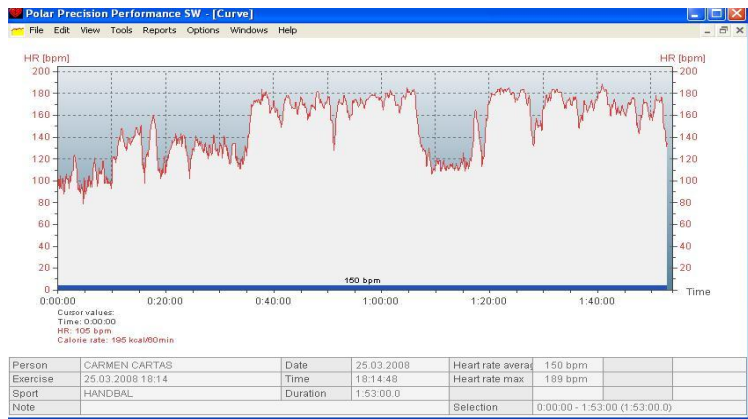


Figure 3. Reference image effort during the match Cetate Devatrans -U. Jolidon Cluj Napoca for the player CC

We observe a clear demarcation of the two halves of the total recording time, or the specific heart rate plateau of the competitive effort.

Another approach to the analyses was the frequency synchronization for groups of 4-5 players with different specializations or identical. This overlapping frequencies recorded were made in order to obtain information on the effort accessed by specialization blocker for the same technical static means used and grafted onto the same type of lesson.

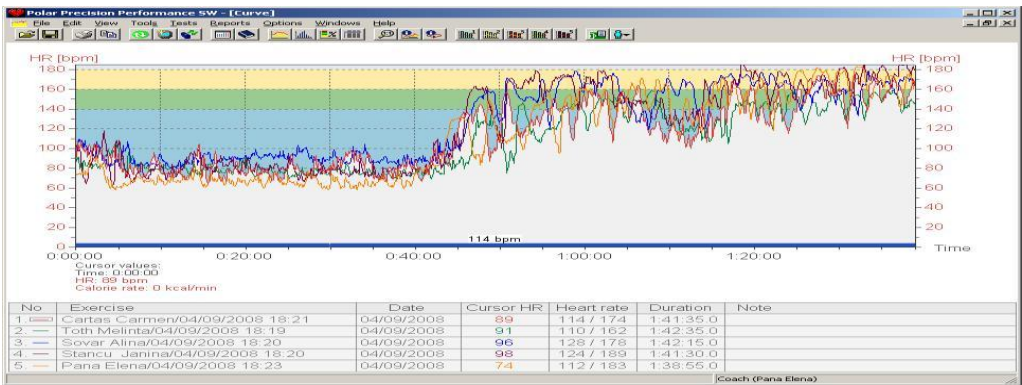


Figure 4. Comparative study of f.c. for the player C.C. in relation to ir., lw., rw. and piv. (precompetitive period)

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Each synchronized picture contains 5 figures of the heart rate corresponding to the 5 players registered in that training or different workouts. The heart rate path is coloured differently for each player. The heart rate compared with the other 4 players is put into a box and is placed in "I" position in each graphic. The main background is white and corresponds to the compared player.

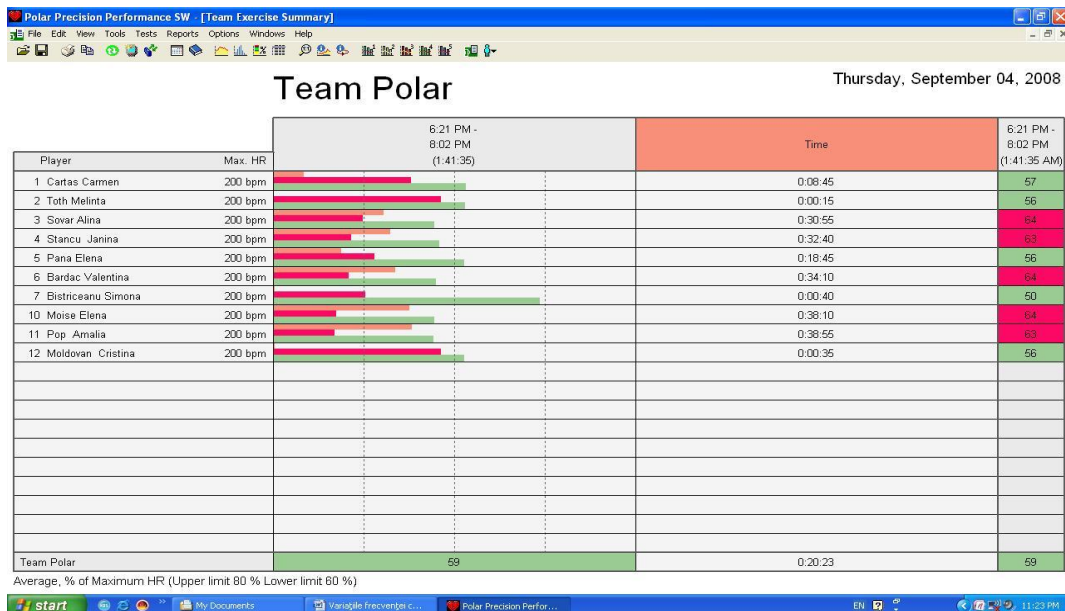


Figure 5. The percentage contribution of each player compared to maximum fc

On the vertical axis (ordinate) is recorded the heart rate and on the horizontal axis (abscissa) is the last average heart rate, the record length and the time of day.

There are also recorded: the name of the player subjected to registration, the registration date, the average heart rate, the maximum heart rate, and the exercise areas bounded by heart rate value.

The graphic is the integration of the comparative study to the overview contribution which it is made to each player for achieving the goals from the lesson. Relating to the maximum f.c. there can be noticed that the training is placed between 60 % and 80% from this and the players get a time contribution as follows: i.l.-8min45sec, i.r.-15sec, lw-30min55sec, rw-32min40sec and piv. 18min45sec.

The second example refers to a recording during the competition, a short lesson, but with high intensity work. There can be seen an access of the submaximal and maximal exercise / supramaximal areas throughout the lesson.

In the recordings made there can be noticed some variations of f.c. between the minimal value of working up – the preparation of the body for exercise (110-120 bpm) and the maximum value of 222 bpm.

Each comparative graphic has four horizontal coloured sections such as:

- light blue - the aerobic efforts area with values of f.c. between the individual heart rate and 140bpm;
- light green - the mixed efforts area -140-160bpm;
- light yellow - the submaximal efforts area-160-18-bpm
- light tile colour - the maximal and supramaximal efforts area-180-222 bpm.

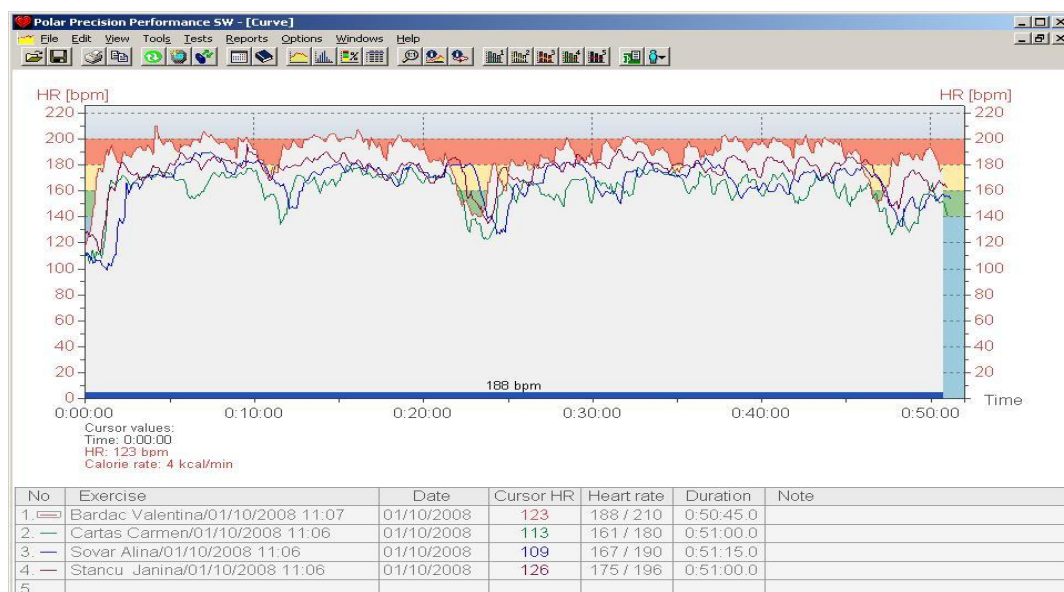


Figure 6. The comparative study of f.c. for B.V. in relation to il., lw., rw. (competitional period 2008-2009)

CONCLUSIONS

1. **The resting heart rate.** Analysing through comparison the initial values with the final ones, we can observe that the 81.67% are related to the initial measurements, and in the end the percentage will be 75.67%. We can assume that there has been a adaptation of the body to the specific effort using some selected ways and utilized in the training process. The value of critical t is 2.31 and calculated t is 2.89. In conclusion $p < 0.05$ ($p = 0.02$) which means that H_0 is rejected and the work hypothesis is accepted.
2. **The average heart rate.** The work hypothesis is accepted following statistical calculation: critical t is 2.31 and and calculated t is 4.54 ($p = 0.00$) and $p \leq 0.05$.
3. **The maximum heart rate.** In this case the initial results do not differ greatly of the final ones even if a slight increase of the recording values was seen (3.39%). The null hypothesis was accepted and the work hypothesis was rejected. The values of the maximum heart rate are an assembly of top maximum recordings from the training session. This indicator is limited from a physiological standpoint depending on the systolic values that cannot be overcome (critical $t = 2.31$; calculated $t = 1.31$; $p = 0.23$; $p > 0.05$).
4. **The maximal and supramaximal effort** is a relevant indicator as the work hypothesis is accepted. We think that the largest values for the final measurements are indicating the fact that the density of the top maximum effort during the training sessions is higher in minor competitions periods and towards the end of the championship than the precompetition values or the beginning of the championship. (critical $t = 2.31$; calculated $t = 2.58$; $p = 0.03$; $p < 0.05$). There are some significant differences between the initial recordings and the final ones.
5. **The submaximal effort** is another important indicator whose research hypothesis is accepted. The value of critical $t = 2.31$; calculated $t = 4.42$, $p = 0.00$; and $p < 0.05$ thus the null hypothesis is

rejected. This type of effort is the most accessed during the training sessions as shown by the differences between the final values and the initial ones.

6. **The moderate effort** has lower final values than the ones recorded at the beginning. Thus the percentage of the training sessions during competitions is lower in relation to the maximal and supramaximal effort (critical $t=2.31$; calculated $t=3.41$; $p=0.01$; $p<0.05$). The null hypothesis is rejected and the work hypothesis is accepted.
7. **The aerobic effort** has the final values lower than the initial ones. critical $t=2.31$; calculated $t=3.45$; $p=0.01$; $p<0.05$. The work hypothesis is accepted. Some significant differences may be noticed to the initial and final measurements.
8. **The energy consumption per minute** was recorded with lower initial values than the final values according to the statistical calculations made on a large number of data collected with the help of the Team Polar System. The energy consumption per minute is recording during the training lesson significant oscillations with increasing trends in the competition period. The null hypothesis is rejected ($p=0.05$)
9. **The total energy consumption** was recorded for establishing the caloric value of the food ration required by an energy balance specific to the handball game and for comparing the obtained values with the existing ones. This indicator depends greatly on the lengths of the training lesson and the intensity of the effort.

The value of total pulsation recorded during the training session has not shown significant differences, thus the null hypothesis was accepted. The number of pulsations measured is lower at the end of the experiment being in relation to the average lengths values of the lessons. There may be noticed that the learning process has led to a specific adaptation of the body to the effort made during the handball game revealing in this way a direct connection between the decreasing of the pulse in resting conditions for the final measurements. (critical $t=2.31$; calculated $t=0.28$; $p=0.17$; $p>0.05$).

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