

SUMMARY OF THE DOCTORAL THESIS

**TITLE OF THE THESIS: Strategies for developing the aerobic effort capacity in athletics running events at children level**

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**Key words:** strategies, aerobic effort capacity, running events, athletics, children

**Introduction**

The child has physiological and psychological characteristics which make him different from an adult. In order to plan and to make effectively a training plan for children, we should consider the specific physiological and psychological characteristics for each age, and also the individual particularities. According to the latest research in the field, the maximum consumption of oxygen resistance per kg, can develop under optimum conditions, from the age of 10 years old. At the age of 10-12 years old "rather quickly is reached a maximum oxygen consumption of 60 ml / kg, depending on the genetic peculiarities of each child, and further the progress is very slow and is correlated to the dimensional factors changes of the body and with the cardio respiratory functional capacity "<sup>1</sup>. „Children have a low cardiac output (amount of blood pumped by the heart per minute), a small capacity of the oxygen transport in the blood and VO<sub>2</sub> max is also low. However, the indices for children practicing sport are obviously better than of those children who do not practice sport, which demonstrates a certain adaptation to the training process. Also is worth mentioning the fact that puberty boy model presents a better resistance than puberty girl model, partly because towards the end of puberty, girls have a VO<sub>2</sub> max of 10% -15% lower than boys. We can explain this difference by the fact that VO<sub>2</sub> max is often closely related to body weight, more developed muscular system and lower amount of body fat, feature prevalent in boys"<sup>2</sup>. On the average "boys are better by 10% -20% in physical resistance activities than girls. However VO<sub>2</sub> max improves both in boys and girls before puberty due to training and increasing the size of the lungs, heart and muscular system"<sup>3</sup>.

In this research we intend to capitalize on the wealth of informational literature and present strategies for developing aerobic capacity in children in the running events. Aerobic capacity is a critical factor influencing a future career in athletics. At the same time endurance sport increase exercise capacity, being the most effective alternative, as a measure to improve health and this effort capacity should be improved since childhood.

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<sup>1</sup> Demeter, A. (1994), *Fiziologia efortului sportiv în „Medicina sportivă aplicată”*, Ed. Editis, București, p. 162

<sup>2</sup> Amstrong, N., Kirby, B.J., Welsman, J.R.,(1997), *Children and Exercise XIX*, Ed. E & FN Spon, p. 179

<sup>3</sup> Bompa, T., (2003), *Totul despre pregătirea tinerilor campioni*, Ed. EX PONTO, Constanța, p. 202

*The aim* of the research was to create a development strategy for the aerobic capacity in children running events.

This research includes four studies.

In the first study "**Survey on the opinion of the athletics coaches in Romania regarding the process of training the children**", I have verified the following *hypothesis*: "the concepts of the coaches on carrying out the training in increasing the effort capacity of children are different". *The purpose of the research*: the research aimed to know the opinion of the coaches on addressing the instructional - educational process in athletics, in children 11-12 years old. *Research objective*: achieving an opinion survey of the coaches on knowledge about the process of preparation of children in athletic running events. *The research methods* used were: the survey method - in our research we applied it through a questionnaire. The questionnaire was sent to experts in the field (coaches, teachers) and included 17 questions concerning: selection (3 questions), athletic training children at 11-12 years (6 questions), the means used by coaches in training (3 questions), competitions (3 questions), recovery (2 questions). The questionnaire was applied during the athletic competitions in the 2011-2012 competitive season and is found in the thesis (p. 75). *The research subjects* were represented by 20 trainers/teachers from 20 clubs in the country dealing with the preparation of children. They were questioned about the selection and preparation of children in the running events. An observational research was conducted during May-June 2012, in the cities of Bucharest and Bacau during athletic competitions, before starting the training program based on increased aerobic capacity with the selected children.

The hypothesis **was confirmed**. It is easily observed that there is no unitary view, at the coaches' level, to highlight the evolution in time of care for the child, but it emerges the most immediate concern for the sports results. Based on the findings of this study, we decided to initiate the second study by which to know the development level of the 11 to 12 years old children that can be included in a research group.

In the second study "Ascertaining study on the development of children 11-12 years of Bacau" I intended to verify the following hypothesis: the development level of somatic and motor function of children 11-12 years new selected for practicing athletics, is a good level. The purpose of the research is to know the level of physical and motor development of children 11-12 years. To know the level of physical and motor development we have resorted to an analysis of the results achieved by children in Bacau County. In this study we used the statistical and mathematical method, graphical method and the test method. *The statistical and mathematical method* - as a method, the statistics detaches from the study of mass connections and correlations, the significance of the results obtained on samples, as well as highlighting the evolution of some parameters on the population. This method calculates the usual indicators such as arithmetic mean, standard deviation, coefficient of variance, Student's t-test, by means of which the results are interpreted. Graphic method is used to represent the results of research in order to create images easily perceived of the phenomena investigated. Graphics method represents the expression of the meaning of the data processed in statistical and mathematical terms. Graphical representations are important because they reveal differences in different areas of research and help formulate conclusions. *The tests method and assessment* - assessment instruments used in the main "motor activities are tests and questionnaires, but it is also used the practical test and competition. The test is

used where the aim is the measurement and evaluation of certain characteristics of activities, actions, attitudes"<sup>4</sup>. We used the method of assessment tests, to know the evolution of the group from initial to the final. The test method helps to obtain data analysis which can lead to the development of strategies / directions of development of aerobic capacity in children beneficial for training and competition. The tests and measurements used in this research aimed to assess the development of somatic and motor function of children at this age. The analysis and interpretation of anthropometric indices and functional and motor development is an important action because from the dynamics of these processes can be inferred that the subject is within normal limits, knowing the changes that occur in the body and which are specific to sex and age. The measurements made at different times, at the beginning and the end phases of activities, shows variations in the progress of each student, highlighting the dynamic processes of growth and physical development.

***The subjects of the research*** were represented by 109 children (14 boys aged 11, 41 boys aged 12, 17 girls aged 11 years and 37 girls aged 12 years), students of fifth and sixth grade from 14 schools in Bacau. We emphasize that in the tests carried out in schools, attended only children chosen following the observation and discussion with the physical education teacher of the school. The total number of students observed was 650. In their selection we took into account the ease of movement, endurance, physical appearance, etc.. The research was conducted in Athletics Hall of Bacau. The assessment was carried out during March-June 2012, and the first visit of the doctor employed by the sport club was made to the school medical centre.

To assess the level of development of children, we used tests, anthropometric measurements and motor tests. Somatic measurements (anthropometric) included: height or size, weight, arm span, length of the inferior limbs, thoracic perimeter at rest and at forced inspiration. Measurements were made with a metric tape, a medical device to measure the waist and scales. Motor assessment tests aimed assessment of the endurance speed regimen (running 3x (3 x 20m)), assessment of coxofemoral mobility, upper limb strength under resistance, abdominal strength under resistance, the force of the back under resistance, leg strength under resistance, explosive strength of the legs (long jump on the spot), resistance and speed.

Hypothesis was confirmed.

The correlations tables show that there are some psychomotor skills that positively influence the resistance running. Correlations between the resistance and speed running, long jump from spot, abdominal strength and back strength are significant. Because of these data, we established that in the training plan based on increasing aerobic capacity in children, we should focus on educating the speed, on developing explosive strength of upper limbs, developing abdominal strength and back strength. Lately, at the international level aroused a great emphasis on exercises to strengthen upper body. Stability of the upper body has always been a necessity for harmonious physical development of children's body. Obvious correlation is observed between resistance running results and long jump from spot results, 50 m speed running, abdomen and back tests results, which prompted us to further train these qualities because we believe they

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<sup>4</sup> Tudor V., (2013), *Măsurare și evaluare în sport*, Ed. Discobolul, București, România p.26,

are directly related to good results obtained at the resistance running. This could mean a new strategy to prepare children for this age for the running events.

In order to see the level from which we start in the preparation process, we initiated the third study where we compared the results of the children at 600m and 800 m running events, with those obtained by the children who participated at the indoor National Championship.

In the third study”**Comparative study between the first 10 national results obtained at the indoor season and the first 10 study obtained at the initial assessment**” we aimed to verify the following hypothesis: the motor level of children aged 11 – 12 years old, participating at the national running championship is high compared to the level of the children from our study at the initial assessment.

**The subjects of the research** were the first 20 athletes from the national level (10 girls and 10 boys), who competed at the indoor season at 600 m and 800 m running events.

In this study we used the statistical and mathematical method and the graphical method.

The research was conducted in Athletics Hall in Bucharest, where they held National Championships for Children's indoor season during 30-31.03.2012. Comparing the first 10 results of the children tested in Bacau county, with the results of those included in the competitive system that were ranked in the top 10, we see a difference in value between the two groups. Children who participate in national competitions have a much higher level compared to the tested children. After comparing the results obtained by children in the study group and those ascertaining nationally, there is a difference of 1 minute and 2 seconds, at the 600m event for girls, and 52 seconds, in the running event of 800m, for boys. After analyzing the results of the 109 students tested, we chose a group of 40 children (24 girls and 16 boys) aged between 11 and 12 years. They will be the subjects of the third study. The hypothesis that the motor level of children 11-12 years participating in the national championship athletics in the running events is high, higher than the children we selected in our study, was confirmed.

The fourth study”**Personal contributions regarding the strategies of developing the aerobic effort capacity in the running events at children level**” verifies the following hypothesis:

- The implementation of the strategy IAAF (teamwork), at the beginning of the preparation will lead to habituation of children with effort and practice of athletics;
- The implementation of a training method based on continuous efforts (Fartlek method and marathon method) in children will lead to an increase in aerobic capacity, capability assessed by examination and testing;
- Realization in children 11-12 years of warming that includes a run of 20 minutes will improve capacity to adapt to effort.

**The research purpose** is to verify the effectiveness of three strategies / directions that lead us to develop aerobic capacity in children athletic running events.

**The research objective** is to achieve an experiment aimed to highlight the effectiveness of three strategies for preparing children for athletic running events.

**The research subjects** are 40 children (16 boys and 24 girls) who make up the control group and the experiment group. Children were selected in 2012, out of a total of 109 students from various schools in the city of Bacau.

***The applicative intervention*** took place in Athletics Hall of Bacau from September 2012 to June 2013. Initially - September, October and November training lessons were conducted three times a week, the working time being one hour, and the December to February training lessons have been carried out 4 times a week for one hour and 10 minutes each. In March, April, May June the training lessons were carried out 5 times a week for one hour 20 minutes each. ***The research methods*** are the experiment method, bibliographic study method, statistical and mathematical method, graphical method and the method of tests and assessments. The experiment conducted in this research is to implement three strategies / directions to improve aerobic capacity in children 11-12 years of the experiment group, in the training program applied to selected children. Bibliographic study method is the way in which we know the specifications of the literature on the concept of training and the results produced by it. The authors have treated their work and studies regarding child development issues, the training methodology, preparing the way children will be approached so that they might be drawn to performance and not worked too hard too early.

***The research results regarding the implementation of the development strategies of the aerobic effort capacities in children.*** The training volume gradually increased from 45 km in September 2012 and reaching 120 km in June 2013. The first 3 months of training were to accommodate and adapt to the effort. December, January, February and March were the fundamental stage of preparation, the aimed was to increase the effort capacity and the months of April, May and June were a period of verification of acquisitions made through competitions. In the first three months I used the Fartlek method, since we considered that a prior adjustment is needed using the IAAF and warming running. We used The Fartlek method after the first three months, Tuesdays and Thursdays. Tuesdays at the fartlek running type, the volume was lower than Thursday (2 km), with shorter and more intensive repetition and Thursdays, the volume was higher (3 km), and the pace was more relaxed. I started fartlek method in December with a volume of 2900m and in January the volume reached 4200m. The fartlek running type were on 50m who were running fast, then the on the distance of 100m who were jogging (Tuesday) and 100m running fast with 100 m sustained running(Thursday). We continued to alternate and to increase the effort until we arrived at a distance of 200m. In June, we conducted the training on Thursday which was 200m fast with 100 m moderate, and the 200m were done at race pace. I used the marathon twice a week (Monday and Wednesday). The volume of this method was 6-8 km per workout. In December the 6 km running was done with 6 to 6.5 min / km by athletes, and in June came to 4.10 min / km boys and 5 min / km girls.

***The comparative analysis of statistical data of the experimental group and the control group - boys.*** At the running event 3 x (3x20m) (tab. no. 63) we can notice that the experiment group has a mean for the 20m running of 3,79 sec., and the control group a mean value of 4,1 sec., which represents a difference of 0,31 sec., the experiment group having better results than the control group. At the coxofemural assessment we can notice that the experiment group has a mean of 40,63 cm., and the control group has a mean of 40,00 cm, which represents a difference of 0,63 cm, the experimental group having better results than the control group. In assessing upper limb strength is observed that the experimental group averaged 24.63 repetitions and control group averaged 16.38 repeats, representing a difference of 8.25 repetitions, the experimental group recorded better

results than control group. In assessing abdominal strength is observed that the experimental group averaged 72.00 repetitions and control group averaged 34.5 repetitions, representing a difference of 37.5 repetitions, the experimental group recorded better results than group control. In assessing the strength back is observed that the experimental group averaged 63.25 repetitions and control group averaged 36.75 repeats, representing a difference of 26.5 repetitions, the experimental group recorded better results than group control. When evaluating the leg strength is observed that the experimental group averaged 108.00 repetition and control group averaged 67.63 repeats, representing a difference of 40.37 repetitions, the experimental group recorded better results than control group. At long jump from the spot assessment is observed that the experimental group averaged 1.77 m, while the control group averaged 1.62 m, which represents a difference of 0.15 cm, the experimental group recorded results better than the control group. In the resistance 800m running is seen that the experimental group averaged 167.50 sec., while the control group averaged 190.63 sec., which represents a difference of 23.13 sec. The experimental group recorded better results than the control group. At the 50m speed running is observed that the experimental group averaged 8.17 sec., while the control group averaged 9.08 sec., representing a difference of 0.91 sec. The experimental group recorded better results than the control group.

***The comparative analysis of statistical data of the experimental group and the control group - girls.*** At the running test 3 x (3x20m) (Table no. 65) it is seen that the experimental group averaged 4.35 sec., while the control group averaged 5.18 sec., which represents a difference of 0.83 sec., the experimental group recorded times better than the control group. At the coxofemoral mobility is observed that the experimental group averaged 29.75 cm, while the control group averaged 28.75 cm, which represents a difference of 1.00 cm, the experimental group recorded better results than the control group. At the strength evaluation test of upper limb is noted that the experimental group has an average of 15.8 repetitions, and the control group averaged 13.3 repetitions, which is a difference of 2.50 repetitions, the experimental group recorded better results than the control group. In assessing the abdominal strength is observed that the experimental group averaged 62.5 repetitions and control group averaged 41.0 repetitions, which represents a difference of 21.50 repetitions, the experimental group recorded better results than the control group. In assessing the back strength is observed that the experimental group averaged 49.08 repetitions and control group averaged 37.75 repetitions, which represents a difference of 11.33 repetitions, the experimental group recorded better results than group control. When evaluating the leg strength is observed that the experimental group averaged 55.67 repetitions and control group averaged 42.42 repetitions, which represents a difference of 13.25 repetitions experimental group recorded better results than control group. At the long jump from the spot assessment is observed that the experimental group averaged 1.54 m, while the control group averaged 1.52 m, which represents a difference of 0.02 cm, the experimental group recorded results better than the control group. In the 600m resistance running is seen that the experimental group averaged 127.42 seconds while the control group averaged 166.83 sec, which represents a difference of 39.41 sec, the experimental group recorded better results than control group. In the 50m speed running is observed that the experimental group averaged 8.83 sec, while the control group averaged 9.42 sec, which represents a difference of 0.59 sec, the experimental group recorded times better than group control.

**Conclusions.** The correlations made between the initial and final averages show that there is real progress from the results obtained in the initial phase and final phase obtained from all tests, which emphasizes the correct choice of tests and assessment exams. The correlations made between the experiment group of boys and girls, show a good inverse correlation between the results obtained at resistance running on 600/800 m, vital capacity and Cooper test. The statistical data achieved in this study confirmed the hypothesis. Thus, in the case of girls, on the 600m running event, the value of t obtained is  $t(14.250) = 10.426$ . Effect size is given by the value of  $r^2 = 0.917$  (indicating a rate of 92%, which means that the applied training program had a large effect), for boys, the sample of 800, the value of t obtained is  $t(9.601) = 9.305$ . Effect size is given by the value of  $r^2 = 0.714$  (indicating a 71%, which means that the strategy applied had a large effect), as shown in the Annex.

**General conclusions:**

- at this level for this category of tests, the teamwork provided in the guide " IAAF Kid`s Athletics" is useful in the first part of the preparation process, i.e., in our case, has yielded good results in phase initiation and training of the experimental group (3 months);
- according to the training plans made and presented in the research, preparing children for running events can be achieved by the training lessons consisting of sub maximal intensity efforts, but on a long-term basis (volume);
- a new training strategy resulting from research, is that a run of 20 minutes at the beginning of each training causes a greater increase in VO<sub>2</sub>max compared to the percentages given in the literature and presented in the paper. In support of this statement are the results we have obtained in the research, the application of Cooper test, where VO<sub>2</sub> max values obtained by the boys in the experiment group, recorded an increase of 33.99% compared to baseline and for the girls in the group had a percentage improvement of VO<sub>2</sub>max of 29.48% compared to baseline, while subjects in the control group showed an increase in this parameter only with 19.92% boys and 17.81% for girls;
- improving aerobic capacity in children can be obtained by applying the principle of gradual increase in the volume and intensity of work and marathon fartlek method. Our experiment demonstrated that a gradual increase in workload from 45 km in September, 120 km in June, by the fartlek method and marathon method (twice a week) resulted in completion of 6 km in a tempo of 4.10 min / km boys and 5 min / km girls in June, starting from a general tempo (girls and boys) of 6-6.5 min / km in September. On the other hand, if in September, in 20 minutes were done 2 km of running, in June the in same period the boys were done 4 km for boys and 3.5 km for girls. Also we note the tremendous progress of subject N.D. which in the competitions organized by FRA, has progressed from 5.03 min in the 1500m running event to 4.55 min and this resulted in a bronze medal at the National Championships for children I;
- from a functional point of view, the implementation of the methods mentioned above, affected the body of children positively. The subjects in the experimental group at Ruffier test had, on average, an improvement of adaptation to effort with 3.01 in boys and 2.22 in girls, compared to only 2.85 in boys and 0.86 the girls in the control group and at the spirometry test we noticed an improvement in the

vital forced capacity of the boys in the experiment group with 2.11% more than control group boys and girls in the experimental group improved their vital capacity with 3.78% more than girls in the control group.

- in terms of motor improvement, the means selected and applied in experimental training program (presented in the work plans and related training), have proven effective, especially in terms of the level of development of upper limb strength, abdominal strength and back strength. In all, the results of children in the experimental group are higher than those of the control group.

As a general conclusion we can say that our research has achieved the main aim of implementing a training plan based on increasing aerobic capacity