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SOME FUNCTIONAL CAPABILITIES OF YOUNG CHILDREN IN THE FUNCTION OF SATISFYING DEVELOPMENTAL REQUIREMENTS

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Abstract

The authors studying functional capabilities of children in the last twenty years find that young children are "long-distancers" and not sprinters. Van Aaken even found that children run between six and fifteen kilometres during their daily playing. Our study analyses the results of a 1000 m run for one-hundred children of both genders, between five and six-and-a-half years of age. Analyses show that the children of this age cover this distance running in between 7 min. 30 s and 8 min. 20 s, while having a maximal heart rate between 196 and 199 beats per minute (their resting heart rate is between 94 and 100 beats per minute).

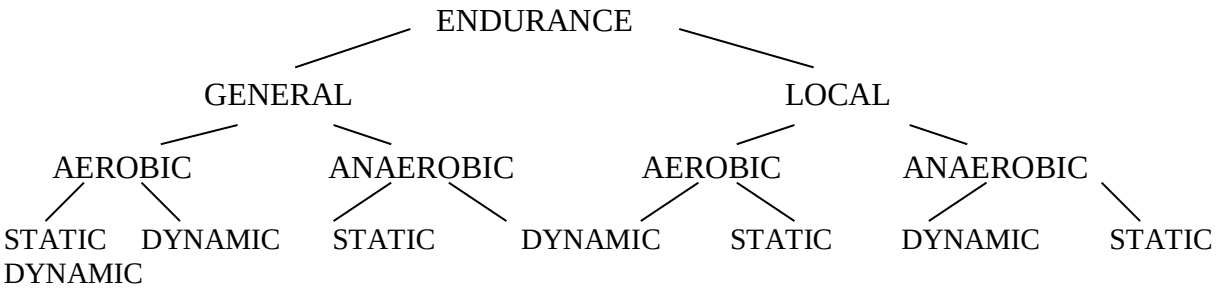
Keywords: children, running, 1000m, times, heart rate

Introduction

Endurance is the functional ability of the organism for longer-lasting execution of motor activity, without degradation of the performance efficiency of this activity. It is therefore characterised by a longer lasting activity of medium intensity, its level being defined by respiratory, cardio-vascular and nervous sub-systems. Oxidative processes also play an important role. All the above-mentioned sub-systems co-operate in the adaptation of the organism to longer-lasting medium level efforts, mostly in resisting muscular fatigue or rather raising the fatigue threshold. We therefore in praxis equate general aerobic endurance with the basic condition of an individual, which also affects the person's immunity capability.

The association between general endurance and the resistance of the organism can be shown with the following formula: BETTER ENDURANCE = BETTER HEALTH.

Hollmann and Hetinger (1980; after: Buschmann, 1986) constructed the following model of endurance:



Hollman (1980) set the ratio between local and general endurance on the basis of the amount of activated muscular mass: less than 1/6 represents local, more than 1/6 muscular mass included into activity represents general aerobic endurance. Aerobic endurance can be

separated from anaerobic endurance by the level of intensity of physical effort, defined by the energy processes in the muscles: in oxidative, where the effort is low, there is a oxygen balance during the whole period of the activity; in aerobic, that is higher effort, a smaller or greater oxygen debt is being created. The classification into static (holds, postures, and hangs) and dynamic endurance (locomotor activity) comes from the structure or quality of movement (Bravničar-Lasan, 1996).

For pedagogic, recreational and preventive purposes the general aerobic endurance is important. Hollman (1980) classifies it into short (3-10 min.), medium (10-30 min.) and longer (above 30 min.). However, this is valid for adults, whether it is true also for younger children remains to be proven.

In this work we study some functional abilities of younger children with the help of a 1000 m run and the heart rate during this activity. Children have a significantly higher heart rate already at rest than adults, who range between 60-80 b/min. (Ušaj, 1995). Buschman (1986) gives a value of 90 b/min. for eight-year olds, under 90 b/min. for ten-year olds, 80 b/min. for twenty-year olds and 70 b/min. for untrained adults. Rajtmajer gives the following values: 100-110 b/min. for six-year olds (1994a) and between 80 b/min. and 110 b/min. for six-and-a-half-year olds (1997). GErsony (1987, PO RAJTMAJER, 1998, STR. 151) also gives in the Paediatric Encyclopaedia similar values of 110-110 b/min., but less precisely – in the age group up to six years. Of course extreme values (min., max.) are very unreliable, since they represent only a very small percentage of the subjects, which is statistically unrepresentative and at the same time hide possibly large measurement error. Therefore we also require some measure of central tendency, that is the arithmetic mean, and standard deviation. GErsony gives a mean value of 97 b/min., Rajtmajer also 97 b/min. - 93 b/min. for boys and 99 b/min. for girls. The heart rate variability data show that this value is quite a variable measure already in a state of rest, since it is affected by a series of psychosomatic factors, and especially a non-uniform measurement protocol, which probably cannot be fully unified for multiple measurement groups of younger children.

The question “Do differences in heart rate between untrained adults and children also exist during loading?” is an important one for sport-pedagogical praxis and especially for scientific research. The title of the book by Kleine and Lennartz (1995) “Pulzschlag 130” already suggests that the optimal value of intensity of activity is a heart rate of 130 b/min. for untrained adults, but Rajtmajer measured average pulses of 197 b/min. for girls and 200 b/min. for boys in the six to ten minute runs. There are obviously enormous differences between children and adults, explained by Buschman (1986) as: “.. the organism of a child reacts in longer activity of medium intensity by increasing the pulse frequency, while the organism of an adult reacts by increasing the heart rate volume – minute volume”.

For further scientific study of functional capabilities of younger children in moderate short efforts between six and ten minutes and of course also for the applicative needs of praxis (didactics, methodics of physical education), the information collected in his forty-year praxis by the physician Van Aaken and presented in his book “Das van Aaken Lauflehrbuch” [The van Aaken book on teaching running] (1993) is very important. The basic message is that a child is a born “long-distancer”, therefore developing aerobic endurance is very important from the viewpoint of biological development of the child. In normal conditions, when the child is not over-burdened with daily physically passive activities (school, additional learning, computer and television, travelling by car), the child should run between 5 and 15 km during play. This requirement is posed because of a normal development of the heart muscle and the

spine, the dynamic and rhythmic loads namely facilitate the exchange of oxygen and substances in the inter-vertebral discs. He clearly says that for this one needs optimal intensity of activity in the form of moderate lengthier running several times a day and not a few minutes of gymnastic exercises. He inspected more than 3000 children and precisely states that a healthy 3-4 year-old should already run up to 6 km in daily play.

Scientific research of some functional capabilities on larger groups of children up to age seven was performed till now by Dvorak and Rajtmajer. Dvorak (1993) tested 56 six-and-a-half year old children in a 1000m and a 12 min. run. With factor analysis she obtained a four factor model of running abilities: endurance in speed in up to 100 m runs, short distance running endurance on 300m to 400m, endurance in middle distances from 500 m to 1000 m and endurance in longer distances – the 12 min. running.

Rajtmajer completed four studies in the last six years on running and endurance abilities of young children. In the first study (1994b) he tested 378 five to five-and-a-half year old children of both genders on a 300 m distance. The running tests (50 m to 300 m) were an integral part of a test battery of forty-three motor tests. All the runs had salient projections (for both genders) on the factor the author identified as endurance. The second study of Rajtmajer (1994c) encompassed 1186 children between 3.5 and 6.5 years of age of both genders. They ran the 400 m distance, centile norms were computed for seven populations of children aged six months apart. In the third study Rajtmajer (1996) tested 295 five-and-a-half, six and six-and-a-half year old children in the 1000 m and 12 min. runs. He used the same test as Dvorak, but did not confirm her four-factor model of running abilities. In the fourth study Rajtmajer (1997) then analysed some running abilities and heart rate during aerobic running activity on 1000 m. He obtained the mean pulse at rest (97 b/min.), mean 1000 m running time (7 min. 30 s) and the pulse kinetics on this distance, with an average finish pulse of 197 b/min. (girls) and 200 b/min. (boys).

The starting point of this study was the hypothesis that children this age have a rest pulse between 97 and 110 b/min., that they will run the 1000 m between 7 min. and 8 min. and have a finishing pulse 197-200 b/min. The working hypothesis bases on the finding that there are no gender differences, that all the children will be able to complete the distance without unsurmountable problems and will return to playing with their group immediately after completing the distance.

Methods

Subjects

The subject sample in this study consisted of 100 children of both genders, of 5.5 and 6.5 years of age +/- 30 days, selected at random from a larger group. In order for the child to be selected into the group, s(he) had to be completely healthy.

Procedures

The children were tested with a modified test first used by Dvorak (1993) on a 50 m long circular track with a longitudinal axis of 19.9 m, width of 9 m and a rounding on both sides with a radius of 4.5 m. The track was bounded with stands and a rope, the start and finish line were specially marked. The times were measured with a stop-watch in seconds, the heart rate with an electronic pulse-meter.

The measurements were carried out between 10:00 and 11:00 on an outdoor track. Each child ran alone on the track, a few steps of periodical walking was allowed. The measurers were trained prior to testing.

Data analysis

Each child had an individual test form, which was checked before input, some were excluded from the analysis. Data analysis included descriptive statistics, that is measures of central tendency and variability. The results are shown in a special table and presented in a diagram of the pulse kinetics.

Results

The results are presented in Table 1, average values in running and heart rate are given for both genders together. The columns show the time and heart rate dynamics from 50 m to 1000 m. The heart rate at rest is also shown, with the sample sizes and data ranges (min – max). The average time for children of this age was 7 min. and 34 sec. to 8 min. and 16 sec (the best time was 6 min., the worst 10 min. and 27 sec.). After Hollman, this intensity of activity corresponds to short general aerobic endurance between 3 and 10 minutes. The average heart rate during the running was 196-199 b/min., with a minimum of 163 b/min. and a maximum of 219 b/min.

Discussion

The results of running from 50 m to 1000 m in this study correspond to the running times obtained by Dvorak (1993) and Rajtmajer (1996 and 1997). A comparison between the three sub-samples shows that the times till 400 m are equal, from 500 m onwards till 1000 m the six year olds lag behind. These are already 30 s slower at 800 m, this difference grows to 34 s to the finish in comparison with the 5.5 year old and 42 s in comparison to the 6.5 year old. We have no realistic explanation at the moment for this anomaly, however, a strong possibility exists that it was caused by the measurers with the instructions how the children should run on the track. Part of these instructions namely deals also with the intensity of running, the children are told before the start to run as fast as possible, but that they can also walk a few steps each lap.

The heart rate dynamics (Graph 1) shows much more normal relations between the three sub-samples and does not give a cause for the anomaly of the six year olds' lagging. Only at the 400 m mark is the heart rate of the 5.5 year olds noticeably lower than for the other two groups. The heart rate of the three groups at the finish is identical, since the three beats higher heart rate of the oldest group is probably the consequence of faster running. A similar kinetics of the heart rate was obtained already by Rajtmajer (1994). We can also confirm the finding of Buschman (1986) that untrained children react to physical activity with an enormous rise of heart rate – if we take as a baseline heart rate at rest the index 100, then this increase amounts to a full 97-98% in our study.

Conclusions

A 1000 m run represents for children this age quite an effort, but due to their physiological specifics mentioned by Buschman, the intensity of activity still remains in the bounds of a short-lasting general aerobic endurance. This intensity of activity is quite similar for the three

age groups, non-withstanding the 30 s and more lag of the six-year olds. Heart rate is a more reliable indicator in this case.

The children did not need any regenerative break after finishing the run since they immediately went back to play with their group. However, their answers to the question "Would you be willing to run once again to be timed on such a course in the next few days?" are very interesting. The response of the majority was "no". We can therefore find that running on such a distance caused the feeling of an unknown "pain", which they do not understand, and this turns them away from repeating such an activity. We would suggest exercising aerobic running at a lower heart rate of about 180 b/min., taking into account the individual characteristics of the children. We also find that competitions with the purpose of ranking are not appropriate for children of this age, the running should be with a "playing goal". Even if time has to be measured, it should be only for the purpose of comparison with "one's own prior times". In any case, all involved with longer-lasting running exercise of children should be very critical, as for instance Arndt (1987) in his book "Langlauf in der Kritik!?" [Long distance running under criticism!?]. Arndt namely feels that longer running is also necessary for the children from the viewpoint of "Sport for All" and "Return to Nature" and other orientations. However, he is more pessimistic about the training of running for children, especially from the viewpoint of the Lennartz principle (1979) – "that children prefer longer runs". He namely feels that this principle should be checked with in-depth analyses of the physical and mental state of the children, and especially the training conditions and methods in long distance competitive running of children.

In spite of the relatively small samples in this study, we can still find that the heart rate kinetics remains similar for the different populations during the 1000m running. In light of the previous studies of Rajtmajer (1994a), there are also no significant differences between the genders. Further studies will of course be aimed at confirming these findings on even larger groups of children.

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Table 1: Average running times (in minutes) and heart rate from 50 m to 1000 m

	TIME			PULSE		
Distance/Age	5.5	6.0	6.5	5.5	6.0	6.5
50 m	0.22	0.19	0.21	161	159	153
100 m	0.46	0.38	0.41	177	179	171
200 m	1.30	1.19	/	177	174	/
300 m	2.13	2.10	2.04	180	192	190
400 m	2.56	3.00	2.51	178	192	191
500 m	3.39	3.54	3.39	194	188	190
600 m	4.29	4.44	4.31	194	197	191
700 m	4.59	6.03	/	194	191	/
800 m	6.03	6.33	6.04	195	190	192
900 m	6.51	7.23	/	195	190	/
1000m	7.42	8.16	7.34	196	196	199
Heart rate at rest				98	114	100
subjects	14	36	50	14	36	50
Min-Max on 1000 m	7.50-8.40	6.37-10.27	6-9.10	166 – 211	163 – 219	180 – 219

Graph 1: Heart rate kinetics during running – from 50 m to 1000 m