DEVELOPMENT OF PHYSICAL CHARACTERISTICS IN AN OLYMPIC WOMAN—CHAMPION IN HIGH PLATFORM DIVING

ABSTRACT. — The paper deals with the body development of an Olympic woman champion in high diving who took part in three successive Olympic games, won one gold and one silver Olympic medal, and was European champion. The study describes her development from childhood until adult age, from the beginnings of sport activity, to the top performance, till the end of her sport career. Development of somatometric characters, indices of proportionality changes in body composition, characteristics of body type, changes in posture, muscles development, foot formation, development of biological age and of some functional features were followed in details. In this way it was possible for the first time to describe and by photosomatograms to document specific body characters in an outstanding sportswoman of world highest performance which were already given in childhood and which were only developed during following training.

To sum up we can say that body development of the Olympic woman champion studied from childhood, was in many ways positively adapted and was almost perfect.

Since a very long time we have been meeting inquiries as to what degree inborn physical characters in a sportsman are useful during an intensive performance and to what degree the specific adaptation of the organism is involved. We, however, haven’t yet found in the literature any study describing changes in physical development of a sportsman of the highest world performance level from his childhood until adult age.

In the publications which are supposed to characterise how the organism is influenced by sport activity are usually described conditions in persons who have already reached certain sport efficiency (Correnti V., Zauš B. 1964, Hirata Kin-litsu 1965, Hornof Z., Kremmer M. 1952, Jokl E. 1961, Maas G. D. 1974, Martinovská A. and al. 1966, Novotný V. 1958, Novotný V. 1968, Tanner J. M. 1964). It is hardly possible to characterise these results as consequences of sport activity as we do not know the initial physical condition. Such findings may be considered only as results of the examination of present physical condition of the sportsmen examined. To be able to comprehend more objectively the consequences of great physical load for the body development it is necessary to get results which document the course of development of investigated characters since the time before the beginning of competitive activity. Of course this is very difficult because one succeeds only scarcely to note the details of the development of an individual who later will reach exceptional success. One must follow for many years many individuals who will never reach high efficiency level or who leave sport activity after several unsuccessful years.

We have succeeded to register the development of physical features of an outstanding Czechoslovak woman diver who took part in three successive Olympic games (Mexico 1963, Munich 1972, Montreal 1976) and on the two first named has won successively a gold and a silver medal, and in 1970 the title of European champion.
METHOD

The first examination was realized in 1960 when the girl was 8 years old and was beginning her sport activity in diving. In her sport a mam-
ness she had already then preceding two years preparation in modern gymnastics. At her first ex-
amination beside the basic clinical examination even the basic anthropometric and functional tests were car-
ried out. At that time she had not yet decided whether she wanted to compete in modern gymnastics or diving.

At the second examination in 1965 the young sportswoman was already 13 years old and had already
specialized in diving. Beside the clinical examination a thorough examination of physical development and of some features of functional
ability were carried out. These detailed examinations were then repeated at the age of 15, 19, 21 and 23 when she slowly finishing her compe-
titive activity and was concentrating on university studies. Some earlier examinations were carried out even
between the mentioned years of age.

The detailed examination contained:
1. Sports ana
matic

2. Somatometric examination:
a) Anthropometry of 68 body characters (after Martin R., Salier K. 1957), relative values of the measured body dimensions, indices of body propor-
tions, indices of Rohrer Pignet, Kump, Broghel-Seitz, and Livi-Hirata (Hirata Ki-Iou 1965).
b) Determination of the amount of body fat and weight of lean body mass (LBM) by means of an electronic caliper (Allen T. H. and al. 1956, Bost W. F. 1954, Novotý V. 1971, Paržáková J. 1967) and a single hydrodynam
c) Typological estimation by means of morpho-

3. Somatometric examination:
a)Objective estimation of body posture (Jaroš M. 1958).
b) Estimation of muscle development. Exami-
nation of foot arch by pedobaroscope (Novotý V. 1963).

4. Somatographic examination:
a) Performing of photosomatogragey in 4 pro-
jectors (Novotý V. 1963).
b) Performing of cytograms of thorax (Novotý
M. 1960).
c) Performing of plantogram and its evalua-
tion by the method of Chippoun and Schwartz (No-

ový V. 1965).

5. Biological age:
a) Growth age (Kapalin V. 1970).
b) Dental age (Skaloul 1972).
c) Skeletal age (Kapalin V. 1970).
d) Secondarycharacters (Tannor J. M. 1969).

6. Functional examination:
a) Spiroergometric examination of lung vital
capacity, maximal breathing capacity, forced expiratory
time.
b) Heart rate.
c) Blood pressure (Syst. and Diastr.).
d) Handgrip Test.

d) Hand grip strength.

As comparative material the results of the study of body development and fitness of Czech population in the frame of IBP (International hald-
program) were used (Novotý V. 1973, 1978, No-


RESULTS

1. The anthropometric data were given in the in-
troduction of the paper.

2. Somatometric examination:
a) Basic data of growth of the studied sports-

woman the high platform diver, are shown in Table 1, 2, and in Fig. 1.

Body height. When compared with girls of the same age of Czech population the studied sports-

woman is short. Already at the first examination at the age of 8 when there was no question yet of any

toerous physical load, as to the height she was 75 cm.

The difference has grown somewhat between 8 and 13 years of age, on the other hand a higher speed in growth could be ob-

served between the age of 13 and 17. Thus at the

age of 16 (on the Graph N. 1, the period of Olym-
pic victory is marked with an asterisk and the

silver Olympic victory with a cross) the difference got settled on the level of the first 8 years even

later during maturity.

TABLE 1

<table>
<thead>
<tr>
<th>Age</th>
<th>Absolute values</th>
<th>Values relatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>21</td>
<td>23</td>
</tr>
<tr>
<td>80</td>
<td>150</td>
<td>250</td>
</tr>
<tr>
<td>75</td>
<td>175</td>
<td>275</td>
</tr>
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<td>70</td>
<td>170</td>
<td>270</td>
</tr>
<tr>
<td>65</td>
<td>160</td>
<td>260</td>
</tr>
<tr>
<td>60</td>
<td>150</td>
<td>250</td>
</tr>
<tr>
<td>55</td>
<td>140</td>
<td>240</td>
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<tr>
<td>50</td>
<td>130</td>
<td>230</td>
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<tr>
<td>45</td>
<td>120</td>
<td>220</td>
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<tr>
<td>40</td>
<td>110</td>
<td>210</td>
</tr>
<tr>
<td>35</td>
<td>100</td>
<td>200</td>
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<tr>
<td>30</td>
<td>90</td>
<td>190</td>
</tr>
<tr>
<td>25</td>
<td>80</td>
<td>180</td>
</tr>
<tr>
<td>20</td>
<td>70</td>
<td>170</td>
</tr>
<tr>
<td>15</td>
<td>60</td>
<td>160</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>140</td>
</tr>
<tr>
<td>0</td>
<td>30</td>
<td>130</td>
</tr>
</tbody>
</table>

Body mass. In comparison with general popu-

lation the body mass is smaller, but the course of its changes was not so even as in body height. At the

age of 8 her body mass had the value of 23.5 kg which is about 5% under the norm of body mass in
cz population. At the age of 13 the difference has risen to 1.5 SD, in the following years the difference

tographs a striking decrease of body mass occurred.

The proportionality of body length.

With re-

garded to smaller body height the values of other body dimensions are influenced therewith and it there-

more is advantageous to assess the results in relative rather than in absolute values. The body sitti-

the height position characterizes the length proportionality of the upper and the lower body segment.

In the studied sportswoman the results until the age of 15 showed a distinct predominance

of the length of the lower body segment compared with the upper body. In the adult age it corre-

to normal length proportionality in nor-

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The length of the upper extremity is relatively shorter than the age of 15, in the following period the normal length of the lower extremity is relatively on the level of age increasing. When the girl until the age of 15, later, until adult age above normal. The intramembranous index since childhood until adult age shows a moderate predominance in length of lower extremities in comparison with the upper ones.

**TABLE 2. Changes in ratio of body proportionality in an Olympic women-champion in high diving from 13 until 22 years**

<table>
<thead>
<tr>
<th>Index of body proportionality</th>
<th>AGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Throat breadth 1</td>
<td>87.0</td>
</tr>
<tr>
<td>Throat breadth 2</td>
<td>86.5</td>
</tr>
<tr>
<td>Pelvis breadth</td>
<td>85.0</td>
</tr>
<tr>
<td>Intermetul</td>
<td>78.2</td>
</tr>
<tr>
<td>Upper extremity</td>
<td>107.0</td>
</tr>
<tr>
<td>Lower extremity</td>
<td>67.4</td>
</tr>
<tr>
<td>Foot</td>
<td>62.0</td>
</tr>
<tr>
<td>Humid</td>
<td>63.5</td>
</tr>
<tr>
<td>Pelvis breadth</td>
<td>85.0</td>
</tr>
<tr>
<td>Girdle length</td>
<td>90.0</td>
</tr>
<tr>
<td>Throat breadth</td>
<td>87.0</td>
</tr>
<tr>
<td>Pelvis breadth</td>
<td>85.0</td>
</tr>
<tr>
<td>Upper extremity</td>
<td>107.0</td>
</tr>
<tr>
<td>Lower extremity</td>
<td>67.4</td>
</tr>
<tr>
<td>Foot</td>
<td>62.0</td>
</tr>
<tr>
<td>Humid</td>
<td>63.5</td>
</tr>
<tr>
<td>Pelvis breadth</td>
<td>85.0</td>
</tr>
<tr>
<td>Girdle length</td>
<td>90.0</td>
</tr>
</tbody>
</table>

Proportionality in body width, Bicondomial diameter had an interesting development. Until 13 years of age it was distinctly under norm in absolute value, in relative value above norm. A great width of shoulders of the studied sportswoman is convincingly confirmed by the fact that in further years beside a relatively high value of the bicondomial diameter even absolute value was permanently smaller than relative. From 13 to 23 years the bicondomial diameter in the posterior depth of chest was both absolutely and relatively above the norm. The thoracic index increases. In this period the depth of thorax and during the whole course of development corresponded to the norm of general population, while with the general population it is reached under considerably lower values of breadth and depth of thorax. Distanxia bicondomial is one of the number of parameters which characterize the proportionality of pelvis. The value of this parameter dimmed in contrast to the thorax values were absolutely and relatively lower than the norm of girls of general population, while the difference was growing with the years. The development of the upper extremity is relatively and flexion in the studied sportswoman was in the sense of bigger value and in the course of years was still increasing. The difference between the circulation values between the right and the left upper arm were without greater significance with the exception of their apparent equalization in the course of the years of investigation. The development of forearm circumference showed that they were markedly increasing from normal value, but compared with the presupposed norm at the age of 13, in the relative and absolute values they were higher than above general values. The differences between the right and left forearm were in no way significant. The index of upper extremity circumference in this sense a marked preponderance of the upper arm to the forearm which increased considerably since 19 years of age. The high circumference in the shoulder was in absolute value and relative value under norm since the age of 15, it increased relatively since 19 years of age. The difference between the left and right arm was smaller since the age of 13 and relatively and absolutely smaller than the normal, at the age of 15 and 19 a marked rise of LBM occurred so that even with a small body height and body mass it equaled in the absolute value with general girls population and relatively it exceeded them considerably. The same trend was preserved even at the age of 21, there later appeared a decrease in the LBM value. Close before the time of Olympic victory at the age of 16 the total body mass was 53 kg, the amount of body fat 17.5% LBM 43.7 kg. Before gaining the Olympic medal at the age of 20, the body mass was 54.9 kg the share of body fat 18.1%, LBM 44.9 kg.

The examination of body composition of the studied sportswoman by hydrostatic method was done at the age of 21. The results are shown in Fig. 3. The total amount of body water was 60.6%, solids 22.9%, body fat 17.4% which is less than at the same age by the caliper method (19.9%) and on the contrary the amount of LBM 47.2 kg was higher than in the results determined by the caliper (35.7 kg).

**TABLE 3. Body composition of the Olympic women-champion in high diving (hydrostatic composition)**

<table>
<thead>
<tr>
<th>Age</th>
<th>Body weight (kg)</th>
<th>TBW (%)</th>
<th>Fat (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>70</td>
<td>42.5</td>
<td>16.0</td>
</tr>
<tr>
<td>19</td>
<td>70</td>
<td>42.5</td>
<td>16.0</td>
</tr>
<tr>
<td>21</td>
<td>70</td>
<td>42.5</td>
<td>16.0</td>
</tr>
</tbody>
</table>

**TABLE 4. Changes in the absolute thickness of the Olympic women-champion in high diving.**

The changes in the absolute thickness of the Olympic women-champion in high diving.
The changes in the skinfold thickness in the course of growth and sport activity in the studied woman diver are presented in figures in Table 4. Until the age of 15 the skinfold was thinner on all places than in girls not going in for sports, since the age of 10 it was approximately at their level with the exception of the markedly small thickness of the abdomen skinfold.

The development of body build as a whole is also characterized in the sportswoman followed by a number of indices (Rohrer, Krause, Brügh, Seitz, Piguet, Livi-Hirata), given in Table 5. At the index of Rohrer and Krause even the count over to LHM amount was used, which enables a more accurate assessing of the values of these indices without the share of body fat in the total body mass (Hordon C., Novotny V., 1967).

**Table 5. Indices of body structure of the Olympic women-champion in high diving from childhood until adult age.**

<table>
<thead>
<tr>
<th>Index</th>
<th>13</th>
<th>15</th>
<th>19</th>
<th>21</th>
<th>23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rohrer</td>
<td>1.37</td>
<td>1.33</td>
<td>1.47</td>
<td>1.45</td>
<td>1.46</td>
</tr>
<tr>
<td>Rohrer (LHM)</td>
<td>1.04</td>
<td>1.12</td>
<td>1.14</td>
<td>1.14</td>
<td>1.15</td>
</tr>
<tr>
<td>Krause</td>
<td>1.67</td>
<td>2.07</td>
<td>2.32</td>
<td>2.30</td>
<td>2.31</td>
</tr>
<tr>
<td>Krause (LHM)</td>
<td>1.49</td>
<td>1.78</td>
<td>1.90</td>
<td>1.93</td>
<td>1.14</td>
</tr>
<tr>
<td>Brügh-Seitz (B-index)</td>
<td>51.71</td>
<td>54.38</td>
<td>54.10</td>
<td>54.97</td>
<td>54.97</td>
</tr>
<tr>
<td>Piguet</td>
<td>18.53</td>
<td>18.98</td>
<td>19.70</td>
<td>18.77</td>
<td>18.72</td>
</tr>
<tr>
<td>Livi-Hirata (F-index)</td>
<td>22.71</td>
<td>23.68</td>
<td>24.61</td>
<td>24.38</td>
<td>24.65</td>
</tr>
</tbody>
</table>

3. Sonotomographic examination:

a) Posture: Survey of the results of posture examination on 6 parts of the body is presented in Table 6. Standing position of head, neck, shoulders, the chest formation, abdomen and its posture, were perfect during the whole time. At the age of 13 a bigger incline of the pelvis was noticed, a slight asymmetry of the height of shoulder muscles, scapular alatice, which were leveling from 15 years, increased lumbar lordosis which ousted more markedly even at the age of 19. In the period between 19 and 23 the posture was almost perfect. On the lower extremities since childhood a sign of genu valga, the foot formation showed a slight transversal flattening at 13 and 15 which hasn’t been registered in later years.

**Table 6. Results of sonotomographic evaluation of the posture of the Olympic women-champion in high diving from 13 till 23 years. (Classification: 1: perfect, 2: good, 3: bad, 4: quite bad).**

<table>
<thead>
<tr>
<th>Evaluated parts of posture</th>
<th>15</th>
<th>17</th>
<th>19</th>
<th>21</th>
<th>23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head, neck</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Chest, shoulders</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Abdomen, pelvis</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Curve of backbone (antero-post.)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Position of trunk (frontal plane)</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lower extremities</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

b) Pedobaroscopic examination showed with gradually increasing clearness in the heads of I—IV metatarsus to the formation of posture with a larger load on the foremost part of the foot sole. At the same time a retreat of the edge of the foremost half of inner arch of foot sole pressed by body mass to the pedobaroscope, has been noticed.

c) Development of muscles: At the age of 13 the development of muscles is described in the examination records as very weak. Slightly marked were only n. periscapulae and n. latissimus dorsi.

At the age of 15 the musculature in these parts of body got considerably more marked and joined by distinct increase of arms and calves muscles. Since 19 years considerable development of the musculature of trunk and extremities was evident but it was disappearing more and more under the subcutaneous fat layer. A distinct development of back muscles in the studied sportswoman was characteristic from childhood until adult age.

4. Sonotomographic examination:

a) Photosomatogram: Photosomatogram in 3 projections (Fig. 4a, b, c) made in all periods of examination from 13 until 23 years makes possible objective documentation of results of the studied woman high platform diver body development evolution from the beginning of her competitive activity in high diving over the top of her sport efficiency with the Olympic victory, till the gradual diminishing of training load and even of efficiency. From the photosomatograms a positive trend in posture...
during the competitive activity, a characteristic development of musculature even a later development of subcutaneous fat layer, are also apparent. With the photostomatograms it is possible to document how a girl which was very gracile for the age of 13, was changing in the course of years into a robust woman with a very good body development.

b) Cyrtogram of the chest of the sportswoman made in all the followed periods documents the development of the chest shape. Since childhood a well arched chest was developing harmoniously in width and depth. Cyrtograms (Tilbachov S., Novotny V., 1966) have thus completed somatometric data measured at the macrosternal level, whereas cyrtography was carried out at the xiphisternal level (Fig. 5).

c) Plantogram: Was also taken at every examination from 13 till 23 (Fig. 6). In childhood a lowering of the foot arch especially of the left was apparent. A gradual improvement of the foot formation especially of the transversal foot arch is apparent not only from the plantograms but even from numerical results (Table 7). Index of Chipouxe describing the longitudinal arch didn’t practically change in the right normally arched foot, in the left foot it was gradually lowering and thus indicating improvement of the arch. The Schwartz’s angel, evaluating the transversal arch didn’t change considerably in the right foot either from 13 to 23 years, in the left foot — the arch of which was transversely lowered in the childhood, showed distinct improvement towards normal.

TABLE 7. Results of the foot arch examination according to the photogram from 13 till 23 years of the Olympic woman-champion in high diving.

<table>
<thead>
<tr>
<th>Method</th>
<th>Age</th>
<th>Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index of Chipouxe</td>
<td>13</td>
<td>39.2</td>
</tr>
<tr>
<td>15</td>
<td>29.5</td>
<td>38.5</td>
</tr>
<tr>
<td>19</td>
<td>32.7</td>
<td>38.8</td>
</tr>
<tr>
<td>23</td>
<td>30.0</td>
<td>35.6</td>
</tr>
<tr>
<td>Angle of Schwartz</td>
<td>13</td>
<td>42°</td>
</tr>
<tr>
<td>15</td>
<td>39°</td>
<td>34°</td>
</tr>
<tr>
<td>21</td>
<td>45°</td>
<td>45°</td>
</tr>
<tr>
<td>23</td>
<td>44°</td>
<td>45°</td>
</tr>
</tbody>
</table>

5. Biological age:

The development of biological age in the studied outstanding woman diver, is presented in Table 8. In comparison with the chronological age already at the age of 13 years, at the beginning of the intensive competitive activity, it showed retardation in growth and dental age, even in the development of secondary sexual characters approximately by one and a half of a year. At the age of 15 the retardation in growth has somewhat decreased, in the dental age on the contrary it has increased.

The skeletal age and maturity of secondary characters corresponded to age younger by six months. E.g. the distal phalanges of the thumb was only finishing its fusion, the proximal phalanges of thumb and other fingers were only beginning their fusion, the epiphyses of radius and ulna were only at the stage of capsuling.


<table>
<thead>
<tr>
<th>Chronological age</th>
<th>12.9</th>
<th>14.9</th>
<th>16.2</th>
<th>18.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental age</td>
<td>11.2</td>
<td>12.1</td>
<td>16.2</td>
<td>18.8</td>
</tr>
<tr>
<td>Morphological age</td>
<td>11.6</td>
<td>14.6</td>
<td>15.8</td>
<td>16.8</td>
</tr>
<tr>
<td>Sexual maturation</td>
<td>11.4</td>
<td>12.5</td>
<td>15.2</td>
<td>19.8</td>
</tr>
<tr>
<td>Skeletal age</td>
<td>13.3</td>
<td>17.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At the age of 16 (Olympic championship) a small body growth (apparent already since childhood) of the studied sportswoman began to be remarkably apparent which resulted in a false impression of growth retardation. Other characters of biological age correspond already to the chronological age, the skeletal age at 16 was not registered. At the age of 19 the body height remained at low values and therefore even the growth age appeared as if retarded by 2 years, the skeletal age, however, was really in the stage of maturation which could be expected already at the age of 17. Epiphysis of the radius was only finishing the fusion.

6. Functional examinations:

Results of functional examinations in this place are only of general information. That is why on the Table 9 are only basic results presented which completely a detailed analysis of the studied sportswoman body development. The spiographic examinations showed that vital capacity (VC) at the age of 13 was under the level of general girls both in absolute value as well as in percentage in relationship to individual body factors. At the age of 15 it marked turn towards development of VC appeared and in both evaluation criteria it highly surpassed the values of girls of general population. The highest values were gradually reached at the age of 21, later only a decline was registered. It was likewise with the values of maximal breathing capacity (VCmax) where highest values were reached at the age of 19. Results of examination of forced expiratory volume (FEV) were entirely at the level of healthy normal subjects. The decline of values FEV1sec and FEV1sec is connected with the development of VC in the course of years.

The heart rate corresponds to general norm, in the course of development is raising tendency to bradycardia can be seen. The blood pressure both systolic and diastolic remained at optimal values until optimal until adult age. The Harvard step test made at the age of 16 corresponded to a very good functional efficiency. The same level had even the result of
TABLE 3. Development of basic functional tests in Olympic swimmers' diving from 13 to 23 years.

<table>
<thead>
<tr>
<th>Examination</th>
<th>13</th>
<th>15</th>
<th>17</th>
<th>19</th>
<th>23</th>
</tr>
</thead>
<tbody>
<tr>
<td>VC (ml. BTPS)</td>
<td>240</td>
<td>260</td>
<td>380</td>
<td>350</td>
<td>370</td>
</tr>
<tr>
<td>VC (Lt. VC liter)</td>
<td>140</td>
<td>110</td>
<td>110</td>
<td>120</td>
<td>110</td>
</tr>
<tr>
<td>Vma (ml. BTPS)</td>
<td>300</td>
<td>300</td>
<td>300</td>
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<tr>
<td>FEYmax</td>
<td>80</td>
<td>90</td>
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<tr>
<td>FEYana</td>
<td>80</td>
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<tr>
<td>f</td>
<td>80</td>
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<tr>
<td>BP syst.</td>
<td>110</td>
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<tr>
<td>BP dias.</td>
<td>70</td>
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<tr>
<td>Hand grip strenght</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>ax</td>
<td>20</td>
<td>20</td>
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<td>air</td>
<td>20</td>
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<td>20</td>
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</table>

With an asterisk are marked the results got closely before gaining the golden Olympic medal, with a cross the results got before gaining the silver medal.

With the exception of the height, the standing jump, and the running distance, which could not be determined in children due to their low age, almost all of the functional tests showed a significant improvement in the age range from 13 to 23 years. This is consistent with the general trend of increased physical performance at a younger age in children.

The main goal is the determination whether the sportsman by his state of health and functional fitness is able to cope with great sport load without negative consequences.

REFERENCES


Kraus W., 1925: Physik der Athletik. VEB Gustav Fischer, Jena.


Novotny V., 1964: Miestna morfozna teor ane z osekných morfomarkov v dýchalích veta. Ces. pediatr, 12, 58–78.


SELIGER V., BARTUNEK Z., 1976: Mean values of various indices of physical fitness in the investigation of Czechoslovak population aged 12–55 years. ČSTV, Praha.


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