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# THE INFLUENCE OF THE ANATOMO-MORPHOLOGIC FEATURES ON THE SPORT ACHIEVEMENTS IN SWIMMING

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**Abstract**
This research took into account the premise according to which, swimming, like all the other sports,is susceptible of being perfected.This paper tackles the multi-valent issue of the correlation between the somatic features of the swimmer and the emergence of superior achievements.
*Subjects and Applied Methods*
The research was carried out during a period of two years and it regarded the measurement of the main anthropometric parameters, which are specific to swimming, together with the measurements of the achievements obtained in the specific trials.The subjects were nine-year-old during the testing of the first year and respectively, ten-year-old during the one of the second year.The anthropometric measurements targeted the following values: the waist, the body weight, the biacromial diameter, the bitrohanterian diameter, the handspan, the length of the palm, the length of the foot.The specific trials which were tested were as follows: the 50 metres crawl, the 50 metres back, the 50 metres breaststroke, the 50 metres butterfly.The groups were also chosen with respect to their somatic features in order to emphasize their importance for the evolution of the results.Their training did not differentiate in any parameter, such as the intensity or the volume.The research, as well as the measurements methods of the anthropometric abilities and the measurements used in the specific trials were identical during the period in which the research was carried out.
*Results*
Analysing the information which has been provided and interpreted, it can be observed that, during all the specific trials, the experiment groups (boys and girls) had a more or less significant evolution when compared with the monitored groups, which stresses the importance of the anthropometric parameters for the emergence of superior achievements in swimming, knowing that the training of the latters didn't differentiate in any aspect.
*Conclusions*
Taking into account this data, it can be asserted that the swimmers' somatic features have a direct influence on the emergence of superior sport achievements, the interrelationship between the anthropometric values and the superior sport achievements being thus shaped.
Another important feature is the shape of the swimmer's body, as it is already known that the longiline swimmers, who have bigger body segments, hold a greater advantage when compared with the short ones, which is proved by the results obtained in this research. This research claims to be a methodological point of reference regarding the realisation of the selection process in swimming. This process is a very complex one, being aware of the sportsmen's anthropometric abilities is one of the significant conditions which have to be fulfilled in order not to select individuals who, later, won't fit the specific biotype of the great swimmers, their achievements remaining poor.
*Keywords*: anatomo-morphologic features, achievements, swimming.

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**Introduction**

This topic is quite complex, indirectly targeting and solving problems of the selection process of young swimmers, knowing that this process is very important, detection of talents and of ideal models being one of the main priorities. Also, based on a forecast of the biological development made accurately and scientifically, complemented by a rational training course, superior results can be obtained. There is a number of specific constitutional swimming biotypes in specialised literature whose degree of being achieved depends on the age of the swimmers. If these biotypes are combined with the development of certain capacities and with the improvement of various functional indicators, they can ultimately lead to achieving a high level of performance.

The swimming procedure is also influenced by the anatomic and physiologic features of the sportsman. Through the specific swimming movements, through the specific underwater breathing and through the horizontal position, swimming is radically different from the normal movements of an individual, the upper limbs holding a key role in underwater movement, as long as the legs hold the key role in moving on land. As it is already known, the main areas with which the movement is performed in water are hands and feet.

In a selection process which is carried out scientifically, features which cannot be perfected have a major role in the first phase of selection, the perfectible ones being monitored during other phases of the selection. Features that have a high degree of heritability are: stature, limb length, length of various skeletal segments, length of foot and hand size, bitrohanterian diameter, biacromial diameter etc.

The best anthropological type for swimming is the longiline type in which length is predominant in comparison with depth and width. In specialised surveys it has been shown that there are some differences between certain somatic indicators and the specific swimming tests.

Because of the specificity of this Olympic sport, a series of adaptive processes are taking place in the body. The individual weight also has an important influence on the phenomenon of floating, as well as the palms size and the length of the feet. At the same time, learning proper technique together with some favourable somatic indicators and a proper physical training in accordance with the age of the swimmer can be a recipe for success for the selected swimmers.

**Equipment and methods**

This research assumed the hypothesis according to which a selection based on the specific somatic features of the swimmer will determine the emergence of the sport results. This paper tackles the polyvalent matter of the correlation between the somatic features of the swimmer and the emergence of superior results.

The research was carried out during a two-year period and it targeted the measurement of the main anthropometric parameters, which are specific to swimming, together with the measurements of the achievements obtained in the specific tests. The subjects were nine-year-old during the testing of the first year and respectively, ten-year-old during the one of the second year.

The methods and the research procedures which have been used are the following ones: the experimental method, the observation, the bibliographic study, the method of measurements and records, the logic method, the statistical and mathematical method and the graphical method. Statistical processing was based on the following indicators: arithmetic average, median, upper limit, lower limit, range, standard deviation, coefficient of variation. The anthropometric measurements aimed the following indicators: waist, body weight, biacromial diameter, bitrohanterian diameter, span, hand length, the length of the foot. The specific tests were the following: 50 m crawl, 50 m back, 50 m breaststroke and 50m butterfly.

For the attainment of this experiment were tested 16 athletes - 8 boys and 8 girls, divided in two categories of groups: experimental (4 boys and 4 girls) and control (4 boys and 4 girls). Also, the groups were also chosen with respect to their somatic features in order to emphasize their importance for the evolution of the results. Their training did not differentiate in any parameter, such as the intensity or the volume. The research, as well as the measurements methods of the anthropometric abilities and the measurements used in the specific trials were identical during the period in which the research was carried out.

**Results.**

The results are presented and interpreted below interpretation based on 1-5 tables which are statistical values of anthropometric skills both boys and girls in both tests (initial and final) in the experimental groups and control and based on the average values of specific samples tested.

**Table 1.** Statistical values of the anthropometric skills of boys - experiment group

| | **Boys - initial** | | | | | | |
|---|---|---|---|---|---|---|---|
| | Waist | Weight | Biacromial diameter | Bitrohanterian diameter | Span | Hand length | Length of the foot |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Average | 141,88 | 30,63 | 33,00 | 26,25 | 140,25 | 14,88 | 20,75 |
| Minimum | 140 | 28,5 | 32,5 | 26 | 140 | 14,5 | 19,5 |
| Maximum | 146 | 32 | 33,5 | 27 | 141 | 15 | 22 |
| Range | 6 | 3,5 | 1 | 1 | 1 | 0,5 | 2,5 |
| Median | 140,75 | 31 | 33 | 26 | 140 | 15 | 20,75 |
| Standard deviation | 2,78 | 1,55 | 0,41 | 0,50 | 0,50 | 0,25 | 1,19 |
| Coefficient of variability | 1,96 | 5,05 | 1,24 | 1,90 | 0,36 | 1,68 | 5,74 |
| **Boys - final** | | | | | | | |
| Average | 147,13 | 35,18 | 34,23 | 27,15 | 147,70 | 15,98 | 22,13 |
| Minimum | 144 | 33 | 33,7 | 27 | 146 | 15,5 | 21,5 |
| Maximum | 148,5 | 37,8 | 34,9 | 27,5 | 148,3 | 16,4 | 23 |
| Range | 4,5 | 4,8 | 1,2 | 0,5 | 2,3 | 0,9 | 1,5 |
| Median | 148 | 34,95 | 34,15 | 27,05 | 148,25 | 16 | 22 |
| Standard deviation | 2,10 | 1,98 | 0,50 | 0,24 | 1,13 | 0,37 | 0,75 |
| Coefficient of variability | 1,43 | 5,62 | 1,46 | 0,88 | 0,77 | 2,31 | 3,39 |

**Table 2.** Statistical values of the anthropometric skills of girls – experiment group.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Girls - initial** | | | | | | | |
| | Waist | Weight | Biacromial diameter | Bitrohanterian diameter | Span | Hand length | Length of the foot |
| Average | 140,38 | 30,13 | 33,13 | 25,88 | 141,63 | 14,93 | 20,55 |
| Minimum | 132 | 28 | 32,5 | 25,5 | 140 | 14,5 | 20 |
| Maximum | 145 | 34 | 33,5 | 26 | 145 | 15,2 | 21,2 |
| Range | 13 | 6 | 1 | 0,5 | 5 | 0,7 | 1,2 |
| Median | 142,25 | 29,25 | 33,25 | 26 | 140,75 | 15 | 20,5 |
| Standard deviation | 5,74 | 2,66 | 0,48 | 0,25 | 2,29 | 0,30 | 0,64 |
| Coefficient of variability | 4,09 | 8,82 | 1,45 | 0,97 | 1,61 | 2,00 | 3,12 |
| **Girls - final** | | | | | | | |
| Average | 146,10 | 32,60 | 33,83 | 28,63 | 145,68 | 15,73 | 22,00 |
| Minimum | 144 | 31,5 | 33,5 | 28 | 144 | 15,5 | 21,5 |
| Maximum | 147,2 | 34 | 34,5 | 29 | 146,5 | 16 | 22,5 |
| Range | 3,2 | 2,5 | 1 | 1 | 2,5 | 0,5 | 1 |
| Median | 146,6 | 32,45 | 33,65 | 28,75 | 146,1 | 15,7 | 22 |
| Standard deviation | 1,47 | 1,04 | 0,46 | 0,48 | 1,14 | 0,22 | 0,58 |
| Coefficient of variability | 1,00 | 3,18 | 1,35 | 1,67 | 0,78 | 1,41 | 2,62 |

**Table 3.** Statistical values of the anthropometric skills of boys - control group

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Boys - initial** | | | | | | | |
| | Waist | Weight | Biacromial | Bitrohanterian | Span | Hand | Length of |

| | | | diameter | diameter | | length | the foot |
|---|---|---|---|---|---|---|---|
| Average | 137,50 | 28,25 | 32,13 | 25,75 | 138,50 | 14,50 | 20,13 |
| Minimum | 136 | 27 | 31,7 | 25 | 137 | 14 | 20 |
| Maximum | 140 | 30 | 32,6 | 26 | 142 | 15 | 20,5 |
| Range | 4 | 3 | 0,9 | 1 | 5 | 1 | 0,5 |
| Median | 137 | 28 | 32,1 | 26 | 137,5 | 14,5 | 20 |
| Standard deviation | 1,91 | 1,50 | 0,44 | 0,50 | 2,38 | 0,58 | 0,25 |
| Coefficient of variability | 1,39 | 5,31 | 1,38 | 1,94 | 1,72 | 3,98 | 1,24 |
| **Boys - final** | | | | | | | |
| Average | 143,25 | 32,15 | 33,10 | 27,18 | 144,75 | 15,05 | 21,88 |
| Minimum | 142 | 31,2 | 32,8 | 27 | 143 | 15 | 21,5 |
| Maximum | 146 | 33,6 | 33,4 | 27,5 | 148 | 15,2 | 22,5 |
| Range | 4 | 2,4 | 0,6 | 0,5 | 5 | 0,2 | 1 |
| Median | 142,5 | 31,9 | 33,1 | 27,1 | 144 | 15 | 21,75 |
| Standard deviation | 1,89 | 1,10 | 0,26 | 0,24 | 2,36 | 0,10 | 0,48 |
| Coefficient of variability | 1,32 | 3,42 | 0,78 | 0,87 | 1,63 | 0,66 | 2,19 |

**Table 4.** Statistical values of the anthropometric skills of girls – control group.

| | **Girls - initial** | | | | | | |
|---|---|---|---|---|---|---|---|
| | Waist | Weight | Biacromial diameter | Bitrohanterian diameter | Span | Hand length | Length of the foot |
| Average | 137,38 | 29,88 | 32,25 | 25,38 | 139,50 | 14,65 | 20,13 |
| Minimum | 132,5 | 27 | 32 | 25 | 136 | 14 | 19,5 |
| Maximum | 142 | 35 | 32,5 | 25,5 | 147 | 15 | 20,5 |
| Range | 9,5 | 8 | 0,5 | 0,5 | 11 | 1 | 1 |
| Median | 137,5 | 28,75 | 32,25 | 25,5 | 137,5 | 14,8 | 20,25 |
| Standard deviation | 3,90 | 3,66 | 0,29 | 0,25 | 5,07 | 0,47 | 0,48 |
| Coefficient of variability | 2,84 | 12,25 | 0,90 | 0,99 | 3,63 | 3,23 | 2,38 |
| **Girls - final** | | | | | | | |
| Average | 144,38 | 32,70 | 33,05 | 26,63 | 144,25 | 15,15 | 21,89 |
| Minimum | 143 | 31,2 | 32,6 | 24 | 143 | 15 | 21,5 |
| Maximum | 147 | 35,8 | 33,4 | 27,5 | 146 | 15,5 | 22,5 |
| Range | 4 | 4,6 | 0,8 | 3,5 | 3 | 0,5 | 1 |
| Median | 143,75 | 31,9 | 33,1 | 27,5 | 144 | 15,05 | 21,75 |
| Standard deviation | 1,80 | 2,17 | 0,34 | 1,75 | 1,26 | 0,24 | 0,48 |
| Coefficient of variability | 1,24 | 6,63 | 1,03 | 6,57 | 0,87 | 1,57 | 2,19 |

**Table 5.** The average values of the samples tested

| | **Boys** | | | | **Girls** | | | |
|---|---|---|---|---|---|---|---|---|
| **Control group** | 50 metres crawl | 50 metres back | 50 metres breaststroke | 50 metres butterfly | 50 metres crawl | 50 metres back | 50 metres breaststroke | 50 metres butterfly |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Arithmetic average **initial** | 39,40 | 46,95 | 49,98 | 46,51 | 40,88 | 47,46 | 50,39 | 47,06 |
| Arithmetic average **final** | 36,75 | 45,65 | 47,70 | 42,10 | 38,29 | 45,98 | 48,43 | 43,04 |
| **Experiment group** | 50 metres crawl | 50 metres back | 50 metres breaststroke | 50 metres butterfly | 50 metres crawl | 50 metres back | 50 metres breaststroke | 50 metres butterfly |
| Arithmetic average **initial** | 39,65 | 46,71 | 49,50 | 46,75 | 40,64 | 47,63 | 49,98 | 46,92 |
| Arithmetic average **final** | 35,95 | 44,48 | 46,82 | 41,40 | 36,45 | 45,12 | 47,14 | 39,34 |

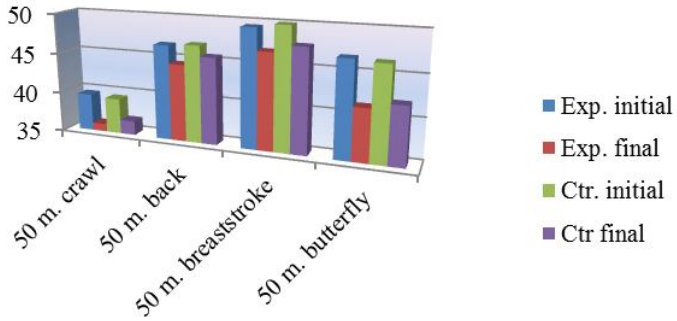


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**Figure 1.** Comparison of the two groups (experimental and control) in samples tested - boys

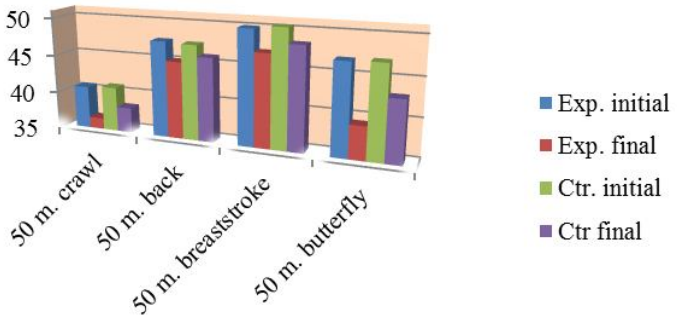


**Figure 2.** Comparison of the two groups (experimental and control) in samples tested – girls

**Discussions**

Within the experimental group (table 1), the average of the waist of the boys is 141.88 cm. in the initial testing and 147.13 in the final one, the difference between the two years is 5.25 cm. However, the value of the weight is 30.63 kg in the former year and 35.18 kg in the latter, which represents a difference of 4.55 kg. These results correspond with. Jivan. I.S. (1999) and Finichiu M. (1998) results.

Also, the biacromial diameter has 33 cm. in the former year and 34.23 cm. in the latter, a difference of 1.23 cm., while the bitrohanterian diameter has an average of 26.25 cm. in the former testing and 27.15 cm. in the latter, a difference of 0.9 cm. The span evinces the biggest increase, which is 7.45 cm., its values being 140.25 cm. in the former year and 147, 70 cm. in the latter.

Regarding the length of palm, the values recorded are 14.88 cm. in the former testing and respectively 15.98 cm. in the latter testing, the increase is 1.10 cm., while the anthropometric parameter named the length of the foot evinces values of 20.75 cm. in the former testing and 22.13 cm. in the latter, the actual increase is 1.38 cm. All the values of these parameters are grouped around the average, this group possessing a high degree of homogeneity, as can be seen in table 1.

From the above table it can be seen that within the experiment group of girls (table 2), the waist average is 140.38 cm. in the former testing and 146.10 cm. in the latter testing, the rise is 5.72 cm., while the average weight is 30.13 kg. the former testing and 32.60 kg. in the latter testing, a difference of 2.47 kg. Regarding the span, the average is 141.63 cm. in the former testing and 145.68 cm. in the latter, the actual increase is 4.05 cm.

In addition, the values of the diameters evince increases, which are variable, the biacromial diameter is 33.13 cm. the first year and 33.83 cm in the second, the increase being of 0.70 cm compared with the bitrohanterian diameter which evinces a length of 25.88 cm. the former test and 28.63 cm. in the latter, the increase is 2.75 cm.

At the same time, the length of the hand evinces an increase of 0.80 cm., the values are 14.93 cm. the first year and 15.73 cm. in the second, while the length of the foot evinces an increase of 1.45 cm., starting from 20.55 cm. in the first testing, reaching 22 cm. in the second testing. The values of the parameters are grouped around the average, excepting for the waist whose values have a high degree of variability, the chosen group evincing a high degree of homogeneity, as can be seen in table 2.

In the control group of boys (table 3), there is an increase of 5.75 cm. of the average value of the waist , the average value being 137.5 cm. in the former testing and respectively 143.25 cm. in the latter testing. The weight also evinces an increase of 3.9 kg., the average value of the first measurement is 28.25 kg. comparatively to the value of the second measurement which is 32.15 kg. The average value of the span is 138.50 cm. in the former testing and 144.75 cm. in the latter, the increase is 6.25 cm. The biacromial diameter keeps its tendency to increase like in the other groups, its values being 32.13 cm. in the former year and 33.10 cm. in the latter year, the average being 0.97 cm. Also, the bitrohanterian diameter evinces increasing values, the average is 25.75 cm. the first test and 27.18 cm. in the second, the increase of the average is of 1.43 cm. The results obtained in this study confirm the words of Jivan I.S. (1999) finding that the waist represents one of the characteristics depending on which the swimmers specialty is realized.

Regarding the length of the hand and the foot, an increase of 0.55 cm. of the first parameter can be observed. For the first parameter, the values are 14.5 cm. in the initial testing and 15.05 cm. in the final testing, compared with the growth of 1.75 cm. of the average length of the foot, the average values being 20.13 cm. and 21.88 cm. All the values of these parameters are clustered around the average, this group possessing a high degree of homogeneity, as can be seen in table 3.

The girls' control group essentially maintains the tendency of increase of values (table 4), the average waist being 137.38 cm. in the initial testing and 144.38 in the final testing, with an increase of 7 cm. In addition, both the weight and the span evince increasing values, the weight gains 2.82 kg. from 29.88 kg. to 32.70 kg., while there is an increase of 4.75 cm. in the average values of the span, 139.50 cm. in the initial testing compared to 144.25 cm. recorded in the final testing. The biacromial diameter evinces an increase of 0.80 cm. (32.25 cm. in the first year and 33.05 cm. in the second) as compared to the development of the bitrohanterian diameter which is 1.25 cm, the values are 25.38 cm. in the former year and 26.63 cm. in the latter.

At the same time, it can be seen the tendency of increasing of the length of the hand (the increase is of 0.50 cm., 14.65 cm. in the first year compared to 15.15 cm in the second) and the length of the foot, with an increase of 1.76 cm from 20.13 cm in the former testing to 21.88 cm. in the latter. All the values of these parameters are clustered around the average, excepting for the span in the initial measurements where the values are highly variable, this group possessing a high degree of homogeneity, as can be seen in table 4.

The calculations of the average of the four specific tests show that the evolution is higher in the experimental groups (table 5), the improvement of the 50 m crawl for the boys in the experimental group is 3.70 seconds and 2.65 seconds in the control group, the results obtained in the second year are 35.95 seconds in the first group and 36.75 in the second group. In girls, the final test results were 38.29 seconds in the control group and 36.45 in the experiment group, the progress of the former group being 2.59 seconds compared with the experiment group who had a progress of 4.19 seconds. These results correspond with Badescu V.et al., (2008) and Finichiu M. (1998) results.

In the 50 m back test, the boys' average is 45.65 seconds in the final testing in the control group and 44.48 seconds in the experiment group, the increase being 1.30 seconds in the former group and 2.23 seconds in the latter group, while in girls the average values were 45.98 seconds in the control group and 45.12 in the experiment, the actual progress is 1.48 seconds in the former group and 2.51 seconds in the latter group.

The 50 m breaststroke test maintains the growing tendency that we have seen in the previously interpreted tests, in boys the progress is 2.28 seconds in the control group and 2.68 seconds in the experiment

group, the final results being 47, 70 seconds in the former group and 46.82 seconds in the latter. In girls, the final average values are 48.43 seconds in the control group and 47.14 seconds in the experiment group, the progress of the first group is 1.96 seconds while the evolution is 2.84 seconds in the second, as can be seen in table 5. These results correspond with. Jivan. I.S. (1999) and Finichiu M. (1998) results.

In the 50 m butterfly test the boys' final test values were 42.10 seconds in the control group and 41.40 seconds in the experiment group, the growth was of 4.41 seconds in the first group and 5.35 in the second, while in girls the test showed an average of 43.04 seconds in the control group and 39.34 seconds in the experiment, the progress of the first group is 4.02 seconds and the progress of the second is 7.58 seconds, as can be seen in table 5.

From what is shown above, it can be seen that in all the specific tests, experimental groups (boys and girls) had a breakthrough more or less significant compared to the control groups, which emphasizes the importance of anthropometric parameters in the emergence of superior results in swimming, knowing that their preparation did not differentiate by any parameter of the training (intensity or volume). These results correspond with. Jivan. I.S. (1999) and Finichiu M. (1998) results.

**Conclusions**

Based on these results, we can say that the swimmers' somatic features influence the appearance of superior achievements in sport, being thus shaped the relationship between the anthropometric indices and higher sport results.

The presented study highlights the importance of the anthropometric parameters in the sport branch named swimming, without minimizing the importance of other factors specific to sport performance such as swimming technique, general motional capacity, etc., anthropometric parameters being one of the main criteria for the selection of performers.

Another important feature is the shape of the swimmer's body, knowing that longilin swimmers who have larger sections have an advantage compared to those of small stature, as demonstrated by the results obtained in this study. Also, the heavy specific weight characteristic to the force type, where the waist is relatively smaller and the overly developed muscles impede in achieving top results, studying the parents' somatotype is a modern requirement for selection, thereby eliminating the selection of low-waisted athletes or who evince tendencies towards the endomorph element.

The planned objectives for each sportsperson must take into account the somatic constitution,the functional abilities and the psychological structure of the individual, according to which their specialization on tests and procedures should be realised.

This study is intended to be a methodological point of reference in terms of the realisation of the selection process in swimming, this process is very complex, one of the conditions required to achieve significant performance is being aware of the athletes' anthropometric capabilities in order not to select individuals who later won't fit in the specific biotype of the great swimmers, their results remaining thus poor.

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