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ORIGINAL ARTICLE

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The somatic physique versus the sports result of tennis players of the Pupils' Sports Club "Return" Lomza, Poland

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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Key words: *somatic physique, sports results, level of sports advancement, children*

Abstract

Background: *Individuals who take up professional sport must comply with requirements dependent on the character of the discipline. The requirements refer to motor skills, mental state and somatic physique. A lot of authors claim that somatic physique in tennis is a factor which helps to achieve the highest sports results. Superiority of arms range in the attacking zone makes a game easier for tall players who are more effective in offensive actions as well.*
The purpose of the research was to estimate the somatic physique of children and youth who play tennis in the Pupils' Sports Club "Return" Lomza.

Material/Methods: *The research involved 22 male tennis players and 21 female tennis players aged 7-16 from the Pupils' Sports Club "Return" Lomza.*
In order to estimate somatic physique the following parameters were used: the height rate, the body mass index, the percentage of fat tissue and water in a human body. The Rohrer and the BMI index were calculated. The above results were referred to the tournaments results in which the examined competitors took part.

Results: *The results of research indicate a need for constant, operational and regular monitoring in a view of a larger group practising tennis, which would allow to define dependence between the style of the game and sports results in searching for directions of a satisfactory training process.*

Conclusions: *Among the examined male and female tennis players significant variations of the examined indices of somatic physique were stated.*
There are no unequivocal indications as to the somatic body build for female and male tennis players in the Pupils' Sports Club "Return" Lomza.
The results of research indicate a need for constant, operational and regular monitoring in a view of a larger group practising tennis, which would allow to defining dependences between the style of the game and sports results in search of directions of a satisfactory training process.

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Introduction

The latest dynamic development of professional sport has caused a significant difference between results of an average physical skilled player and results gained by champions. Individuals who take up professional sport must comply with requirements which depend on the character of the disciplines. In tennis the requirements refer to motor skills, mental state and the somatic physique of a player [1,2,3].

A diversity of the types of physique of individuals taking up sport was observed in ancient Greece. Filostratus Flavis described how competitors of particular sports disciplines should be built in order to be able to win. In the Olympic Games athletes were qualified to compete in groups based of somatic physique [4].

In contemporary times the first comprehensive information based on accurate observations referring to competitors' physique dates from the previous century. In 1921 W. Kochlrausch made the first classification of the somatic physique of competitors [5].

Kochanowicz [6], Drozdowski [7], Płatonow [8], Sawczyn [9], Jagiełło [10] and others think that physical skills and effectiveness of the training process in numerous sports disciplines considerably depend on somatic physique, which is an essential criterion of the selection of competitors in professional sport.

According to Ważny [11], Zaporożonow [12], Sozański [12], Raczek [13], Klimczyk [14] and others a competitor's physique is not essential and is not the only, principal factor which has an influence on the level of sports results achieved by competitors. It is just one of many vital elements which affect the process of development of a sports level.

Analysing all features of the physical development of competitors at different levels of advancement in tennis, Królak [15], Ziemann [16], Ziemann and Garsztka [17], Unierzycki and Schefke [18] pay attention to the fact that height, body mass and the composition of the human body have the biggest influence on a sports result.

Tennis belongs to disciplines which are technically diversified and have endless technical variants. It is an interval game with high speed-power training. The effort is of an acyclic type and is characterized by a non-typical structure of movements. During a match a tennis player is forced to react quickly and precisely to a constantly changing stimulus like: distance, height, speed, weather conditions. A tennis match can last even for several hours. A peculiarity of the game, trainings associated with it and on top of this numerous trips require various skills, physical and psychological abilities from competitors [18].

Competitors' somatic physique is a factor which helps to gain the highest sports results. The rectangular shape and the size of a court and the height of the net causes that tall and proportionally built strong tennis players have an advantage over the other players in effective serve, smash and volley. Superiority of arms range in the attacking zone makes a play easier for tall competitors both in a single and a double game. Tall tennis players are more effective in offensive and defensive actions. They are more active in the court depth. It means that the height of the body rate is one of the elements which have the biggest influence on achievements of the best results in tennis [19,20,21].

The purpose of research was to estimate the somatic physique of children and youth taking up tennis in the Pupils' Sports Club "Return" Łomża.

Materials and methods

The research was carried out on the group of 43 tennis players from the Pupils' Sports Club "Return" in June 2011. In this group there were boys and girls aged 7–10. As regards gender, there were 51% boys and 49% girls.

The youngest age categories had the greatest number of tennis players in their groups: aged 9-10 and aged 11-12 included 7-10 competitors. In a group of 13-14-year-olds and 14-15-year-olds nine boys and four girls were involved in the full study. Participation of the groups was different for both genders (Table 1).

Table 1. Age description of the examined groups

Age group	Boys	Girls	**Total**
	N	N	N
Aged 15-16	4	1	5
Aged 13-14	5	3	8
Aged 11-12	5	10	15
Aged 10 and less	8	7	15
In total	**22**	**21**	**43**

In order to estimate anthropometric physique of tennis players, basic developmental parameters were used: the height rate, the body mass index and the percentage of the fat tissue and water in a human body. Data referring to the height rate and the body mass index were gathered directly through a survey, and on their basis the Rohrer and the BMI indices were counted [22,23,24]. The percentage content of the fat tissue and water in a human body was defined by using a TANITA BC 1000 scales.

In the research results of tennis tournaments were analysed. Tennis players' age and gender were taken into consideration in the research as well. Participants were divided into the youth age categories which were defined by the Polish Tennis Association: players aged 15-16, players aged 13-14, players aged 11-12, and players aged 10 and less.

The statistical analysis of results was carried out by means of a descriptive statistical method which used a description of the schedule of variables with the help of measure position, variability, asymmetry and concentration. The results which were obtained from gathered measurements were presented in diagrams and charts, and statistical analysis was carried out using the t-Student test. Statistical conclusions were drawn using the conventional level of significance at $p<0.05$. The description and interpretation of dependence of a variable was defined on the basis of the Pearson correlation coefficient.

Results

Analysing results of research on the height of teenagers taking up tennis in the Pupils' Sports Club "Return" Łomża, a considerable variation in particular age categories among boys and girls can be seen (Figure 1). The highest variation was noted in the group of girls aged 11-12. The shortest girl was 133 cm and the tallest one was 163 cm tall.

Analysing medium values of the examined parameters, one can observe a certain regularity of development. The variations range from 12 to 20 cm in both the group of girls and of boys. A slightly higher variation in the group of boys aged 11-12 and 13-14 is observed. A significant variation in the group of girls was noted between those training at the age of 10 and those aged 11-12. The height of boys in the group aged 15-16 was between 169-170 cm. However, a female participant was 159 cm tall and was shorter by 5 cm than an average female participant in the group aged 13-14.

In the body mass, a considerably higher indicator can be seen in the female participant who was 63 kg in comparison with the mean value of a group aged 13-14, being 46 kg. An interesting fact is that in the group of tennis players aged 15-16, lower parameters of the body mass indicator were stated than in the group aged 13-14 (by about 10 kg) in spite of the higher height rates of a body (by about 6 cm) (Figure 2). It is possible that the above results are caused by the fact of differentiated numbers in the examined groups of tennis players especially in a small group aged 15-16.

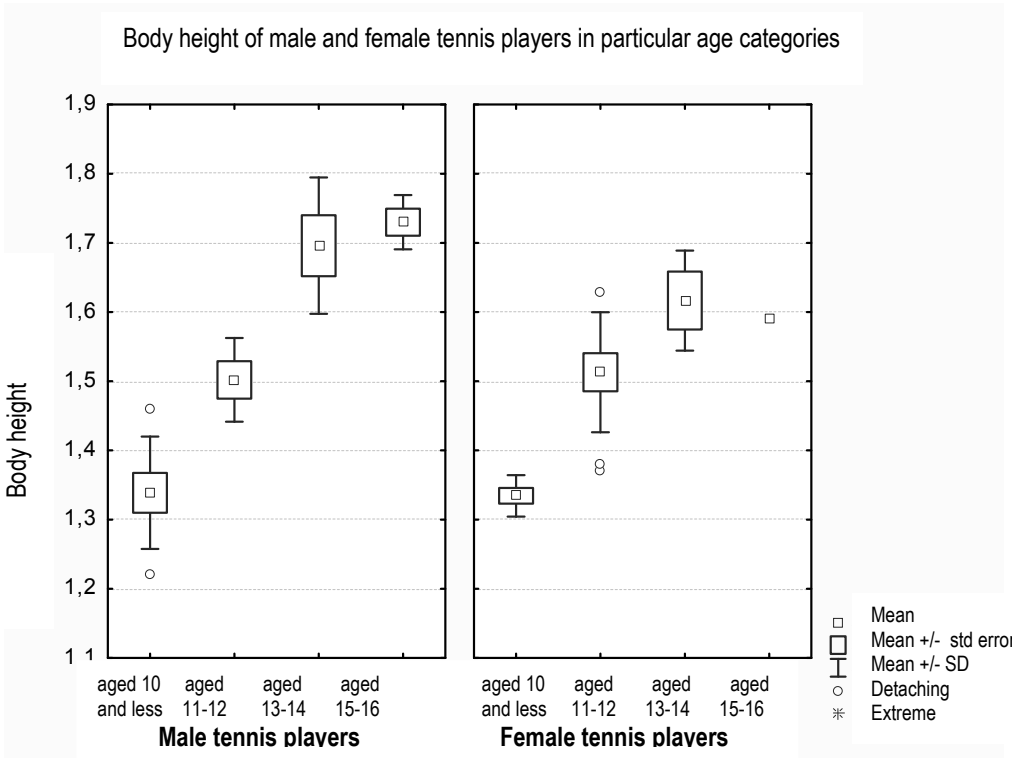

Fig. 1. Body height in particular age categories

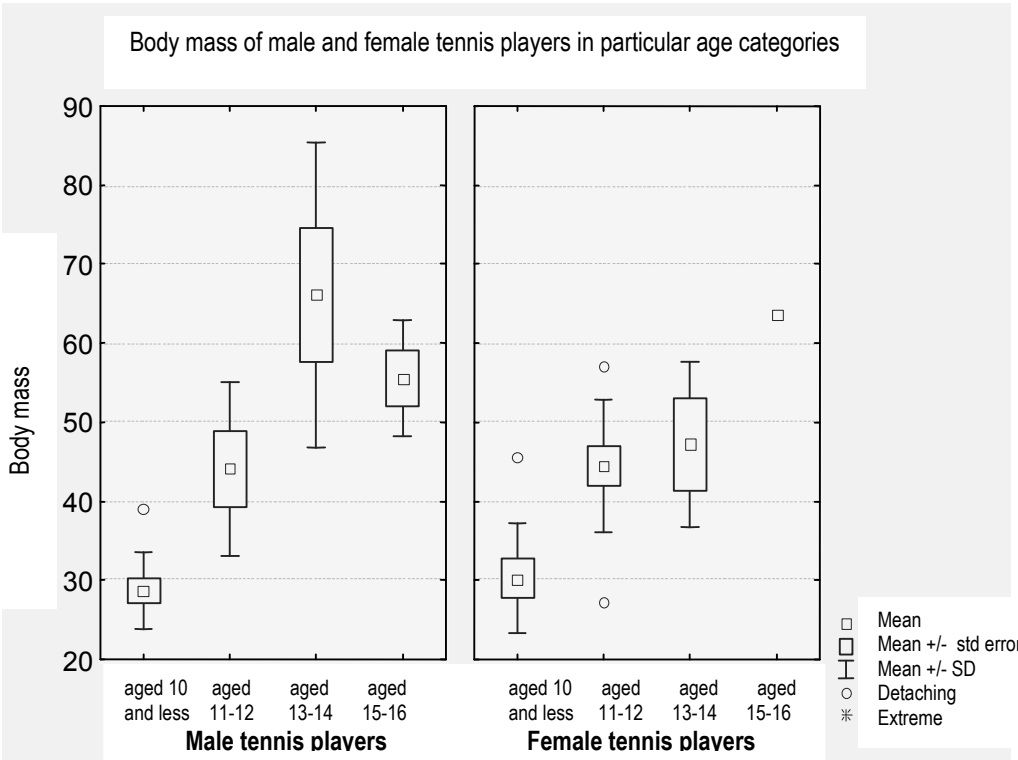

Fig. 2. Body weight in particular age categories

In order to define the level of body weight status, percentiles were used. A general division for boys and girls aged 2-20 was applied: underweight – under 5 percentile, standard – ranges from 5 to 85 percentile, overweight – ranges from 85 to 95 percentile obesity – above 95 percentile.

For the majority of the group (31 people) the level of the BMI index was defined as normal. 2 persons were classified as underweight, 4 as overweight persons and 6 as obese persons. The BMI index layout was close for both genders (Table 2).

Table 2. Somatic status of the examined group

BMI Level	Boys	Girls	Total
	N	N	N
Underweight	1	1	2
Normal	16	15	31
Overweight	2	2	4
Obesity	3	3	6
In total	**22**	**21**	**43**

The Rohrer index for each participant of the research was calculated; it is one of the so-called weight-height indicators which characterizes a degree of slenderness or obesity of physique of a human body.

The Rohrer index for boys playing tennis took a medium value of 1.21 and for girls 1.25. For half of the examined girls and boys the Rohrer index did not exceed the value of 1.16. There was a slight difference at the gained minimum: boys – 0.96 , girls – 1.03. However, the maximum value was much higher for girls – 1.91 (boys – 1.69). Among the examined group, Rohrer index remained within the bound of value 1.06 for 25% of tennis players and for 25% cases, it was higher than 1.33 (Table 3).

Table 3. The value of the Rohrer index of the examined group

Group	Medium	Median	Minimum	Maximum	Lower quartile	Uppers quartile
Boys	1.21	1.16	0.95	1.69	1.10	1.30
Girls	1.25	1.16	1.03	1.91	1.06	1.35

An analysis of correlation showed statistically significant independence between the BMI and the Rohrer index. Only for boys (the Pearson correlation coefficient rxy = 0.79, L<0.001 , the correlation was extremely high) (Table 4).

Table 4. Correlations between the BMI and the Rohrer index

Group	r_{xy}	r2	t	p*	Correlation
Boys	**0.79**	**0.62**	**5.69**	**<0.001**	**very high**
Girls	0.36	0.13	1.66	0.11	lack of significance

** level of significance p<0.05*

In the groups aged 13-14 and 15-16 the correlation between the BMI and the Rohrer index showed statistically significant dependence 0.96-0.99 (Table 5). The correlation between boys and girls from groups aged 11-12 and 10 and less were not noticed.

Table 5. Correlations between the BMI and the Rohrer index in the group of male tennis players in particular age categories

Group	r_{xy}	r2	t	p*	Correlation
Aged 15-16	**0.99**	**0.99**	**23.06**	**0.002**	**nearly full**
Aged 13-14	**0.96**	**0.93**	**6.19**	**0.008**	**nearly full**
Aged 11-12	0.79	0.63	2.25	0.110	lack of significance
Aged 10 and less	0.71	0.50	2.44	0.051	lack of significance

** level of significance p<0.05*

In the case of girls, statistically significant dependence at the level of 0.81 was noted only in the age group 11-12. No dependence of correlation between the BMI and the Rohrer index was noticed either in the group of girls under 11 years of age or in the group of teenagers (13-14 years old). In the category aged 15-16, because of the fact that only one participant took part in the research, it was impossible to calculate a correlation (Table 6).

Table 6. Correlations between the BMI and the Rohrer index in the group of female tennis players in particular age categories

Group	r_{xy}	r2	t	p*	Correlation
Aged 15-16	*insufficient number of cases, it is impossible to calculate a correlation*				
Aged 13-14	0.99	0.99	9.93	0.063	lack of significance
Aged 11-12	**0.81**	**0.66**	**3.97**	**0.004**	**very high**
Aged 10 and less	-0.32	0.10	-0.75	0.488	lack of significance

** level of significance p<0.05*

An analysis of correlations between sports achievements defined on the basis of tournament results, body height, body weight and the BMI index of tennis players in particular age categories failed to show statistically significant values.

However, a high correlation between sports results and the percentage content of the fat tissue in the group of boys in the category aged 13-14 was noted (Table 7). It is formed at the level of 0.92. Negative dependence of the above indicators at the level -0.90 among 15-16-year-olds results from the lower body mass index (Figure 1).

Table 7. Correlations between tennis results and percentage of content of the fat tissue in tennis players in particular age categories

Group	r_{xy}	r2	T	p*	Correlation
Aged 15-16	-0.900401	0.810721	-2.92685	0.099599	lack of significance
Aged 13-14	**0.926393**	**0.858203**	**4.26111**	**0.023706**	**nearly full**
Aged 11-12	-0.404833	0.163890	-0.76684	0.498998	lack of significance
Aged 10 and less	-0.487947	0.238092	-1.36929	0.219947	lack of significance

** level of significance p<0.05*

An extremely high correlation was noted between results of sports competition and percentage content of water in a human body (-0.93) in the group of boys in the age category 13-14 years old. There is an apparent independence but it is not statistically vital in the group aged 15-16 years old. Results of the correlation are shown in Table 8.

Table 8. Correlations between results in a tournament versus content of water in tennis players' bodies in particular age categories

Group	r_{xy}	r2	T	p*	Correlation
Aged 15-16	0.899141	0.808454	2.90541	0.100859	lack of significance
Aged 13-14	**-0.934140**	**0.872618**	**-4.53334**	**0.020088**	**nearly full**
Aged 11-12	0.407460	0.166024	0.77280	0.495942	lack of significance
Aged 10 and less	-0.487936	0.238081	-1.36925	0.219959	lack of significance

** level of significance p<0.05*

Correlations between results in a tournament and the Rohrer index were examined with consideration of the age category of participating tennis players. An extremely high correlation between results of the tournament and the Rohrer index among boys in the category 13-14 years old was noted. Negative dependence is observed but it is not statistically significant in the group aged 15-16 years old, which demonstrated a lower indicator of lipomatosis and body weight. Table 9 shows results of the correlation.

Table 9. Correlations between results of a tournament and the Rohrer index of participants from particular age categories among boys

Group	r_{xy}	r2	T	p*	Correlation
Aged 15-16	-0.902210	0.813984	-2.95833	0.097790	lack of significance
Aged 13-14	**0.883362**	**0.780328**	**3.26446**	**0.046973**	**very high**
Aged 11-12	-0.354392	0.125594	-0.65643	0.558406	lack of significance
Aged 10 and less	0.372272	0.138586	0.98249	0.363799	lack of significance

** level of significance p<0.05*

An analysis of correlation between results of a tennis tournament and body weight, percentage content of water and fat tissue, an index of slenderness, the Rohrer and the BMI index in the group of examined girls showed no significant dependence in any of the examined age groups.

The only dependence which is statistically significant at the level -0.64 was noted between body height and sports results in the group of girls aged 11-12 (Table 10).

Table 10. Correlations between tournament results and body height of participants from particular age categories among girls

Group	r_{xy}	r2	t	p*	Correlation
Aged 15-16	*insufficient number of cases, it is impossible to calculate correlation*				
Aged 13-14	-0.069116	0.004777	-0.069282	0.955964	lack of significance
Aged 11-12	**-0.642101**	**0.412294**	**-2.36902**	**0.045316**	**high**
Aged 10 and less	-0.506462	0.256504	-1.31339	0.246091	lack of significance

** level of significance p<0.05*

Discussion

M. Skład, M. Kędzierska [25], Łaska-Mierzejewska [26] emphasize that physique plays a vital role in sport. They claim that the type of human physique is a biological feature, to a large extent conditioned genetically, and it is unchangeable in a person's lifespan. Therefore, a proper choice of physique of children candidates to take up a professional sport gives a big chance to those individuals who will follow somatic criteria of the discipline to which they entered during the first selection.

The character of the game and training require physical and psychological predispositions from competitors. According to Juśkiewicz [27], participants who play different styles vary in physique. Participants who use serve and volley while playing have bigger values of lower limbs, first strong serve, smash and perfect volley. However, participants who have longer upper limbs prefer a game in the depth of the court.

The causes of different styles of playing on the court should be searched for in a technical-tactical process of a tennis player's early training period. Unierzycki, Schefke [18] think that a sports result in an early period of taking up sports depends on age, i.e. a stage of biological development.

Ziemann, Garsztka [17], basing on literature and their own wide research carried out on participants aged 15-16 who were qualified in a project of the Polish Tennis Association, underline the importance of changeability of the development of morphological features. They pay attention to a faster development of the body height index in young participants in comparison with their body weight and the opposite tendency in competitors aged 16-17. They claim that the oldest competitors had the most fat-free tissue in the body mass and the youngest ones had the least. This indicator showed an essential dependence compared with the sports level as well. Tennis players who had bigger far-free tissue in their body mass took better places in the ITF rankings.

Research done by E. Ziemann and T. Garsztka [7] demonstrated that the height of the body of 15-year-old tennis players ranges at the level of 165-193 cm with regard to mean value of 175 cm and standard deviation at 7.4. The minimum value of the BMI was 17.4, the max was 22.8 and the mean value 20.1 with standard deviation at 1.4.

Tennis players of the Pupils' Sports Club "Return" Łomża aged 15 had slightly lower mean body height. It was 173 cm and standard deviation 3.9. The tallest competitor was 178 cm high and the shortest one was 169 cm. Height of young tennis players referring to a 7-point scale whose aim is to estimate the quality of somatic physique according to H. Milicerowa's criteria [5]: very tall, tall, above medium, medium, below medium, short, very short oscillated at the level of medium and tall. In the category 13-14 years old also a very tall participant was noted.

A well-known tennis coach Nick Bollettieri [28] suggests that the style of the participants' game must be established on the basis of the physique so that they can achieve a championship level.

An analysis of research results of female and male tennis players aged 7-16 from the Pupils' Sports Club "Return" Łomża demonstrated essential variation of the examined indices of somatic physique for both genders.

Analysing values of the BMI index one can observe a similar percentage of training girls and boys who are underweight 14.5- 14.8%, overweight 9.1- 9.5%, obese 13.6- 14.3% and with normal BMI 71.4- 72%.

The value of Rohrer index in the group of girls was 1.25 and in the group of boys it was 1.21. Higher variations were stated in minimal results 1.03 and 0.95, while the maximum in the group of girls was 1.19 and in the group of boys it was 1.69.

An analysis of correlation between the BMI and the Rohrer index with regard to gender, demonstrated a significant statistical dependence at the level of 0.96-0.99 for boys in the age groups 13-14 and 15-16. However, in the case of girls there was significant statistical dependence at the level of 0.81 in the age group 11-12.

An analysis of correlation between tennis players' results and the percentage of fat tissue, water, and the Rohrer index, demonstrated a significant statistical dependence at the level of 0.88-0.93 in the category 13-14 years old. However, such dependence was stated between tournament results and body height in the group of female tennis players aged 11-12 (Pearson correlation coefficient rxy = -0.64, high correlation).

Conclusions

1. Among the examined male and female tennis players significant variations of the examined indices of somatic physique were stated.
2. There are no unequivocal indications as to the somatic body build for female and male tennis players in the Pupils' Sports Club "Return" Łomża.
3. The results of research indicate a need for constant, operational and regular monitoring in a view of a larger group practising tennis, which would allow to defining dependences between the style of the game and sports results in search of directions of a satisfactory training process.

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