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OBJECTIVE ASSESSMENT OF LOWER LIMBS EXPLOSIVE STRENGTH PERFORMED ON THE PARTICIPANTS OF THE POLISH NATIONWIDE SPECIAL OLYMPICS FOOTBALL TOURNAMENT IN THE SCOPE OF BOTH LEGS JUMP ON THE DYNAMOGRAPHIC PLATFORM

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Abstract

Introduction. Explosive strength is a motor ability defined as an ability to develop a maximum strength in the shortest time. It is an essential feature of many sportspeople, including football players. To assess this strength for lower limbs, the following tests are implemented: CMJ and DJ tests, defined determinants of McClymont reactive strength or K indicator according to Bartonietz. It is also possible to objectively assess the jump research with the use of a dynamographic platform.

Aim of the study. The aim of the research was to determine explosive strength of lower limbs with the use of GAMMA dynamographic platform.
Material and method. The participants of the Polish Nationwide Special Olympics Football Tournament were examined with the use of the GAMMA dynamographic platform. 57 people aged 20-30 were researched (44 boys, 13 girls). On the basis of the results, lower limbs explosive strength was determined.
Results. The research depicted a wide range of the lower limbs explosive strength values of the Football Special Olympics participants. This also suggests significant differences of motor abilities of particular participants taking part in the tournament.
Conclusions. Results concerning the dynamographic platforms usefulness in assessing sportspeople motor abilities as well as explosive strength of young active participants of the Special Olympics were formed.

Introduction

Explosive strength is defined in physical culture sciences as the speed of strength growing in time, which is the ability of a muscle to release the strength fast. This parameter is often examined when assessing the motor potential of a particular participant (to be more precise, a jumping ability potential). Numerous tests are used to define the potential – CMJ and DJ tests, standing long jump as well as the measuring apparatus such as Nottingham leg extensor power rig, dynamographic or dynamometric platforms. McClymont reactive strength determinants and K indicator according to Bartonietz are also used to define the potential [1,2,6]. Explosive strength description helps to assess the motor ability and to interpret it in terms of mental-physical abilities which are revealed in different types of physical activity [7,8].

Football is a very dynamic and spectacular sport. Although the explosive effort constitutes only 5% of the overall play time, the ability to develop it may have a significant influence on a player's effectiveness. Among others, it is used at jumping to reach the ball, hitting the ball with a leg, kicking the ball into the goal, bursts or dynamic starts when running short distance (2-4m) [3]. This also applies to players of the special Olympics.

Different levels of mental disability of the special Olympics players may suggest uneven sport competition during matches. The special Olympics football teams are classified on the basis of the Team

Ability Assessment Test and the assessment of the monitored plays' preliminary round. The test consists of:

- dribbling – controlling the ball in a 12-metre slalom within 1 minute
- ball control and ball passing – after the ball is played, a player must control it when heading the goal, a player must score a goal from any distance, a test is repeated within 1 minute
- kicks – a player in the penalty area runs for a ball, kicks the ball towards the goal from any place in the goal area attempting to kick it when it is in the air [12].

Teams with similar skills take part in the competition. The classification of mental disability in Poland does not take into account the physical features or the motor ability of a particular person. Although the disabled of low and medium level present different motor ability in terms of big groups, those of the highest motor ability may reach similar results. [4,5]. In a case of the football special Olympics, the best players with low or medium mental (not motor) disability take part in it.

Aim of research

The variety of disorders which the special Olympics players suffer from also suggests a different level of physical ability. The aim of the research was to assess explosive strength of lower limbs with the use of GAMMA dynamographic platform. Objective assessment of one parameter determining a player's jumping ability may indicate the differences among the players who compete with each other. It may also display the value of the Team Ability Test performed before the competition starts.

Material and method

The research included the group of 57 football players (44 men, 13 women) aged 20-30 (average 23) who take part in the special Olympics tournament. The group included people with low or medium level of mental disability. The average body weight value of male and female players were accordingly 72,6 kg and 59,1 kg. In the results compilation, 8 players (7 men, 1 woman) were not taken into account as they did not pass the test properly.

Each player performed the CMJ test with a swing which was preceded by two slight test jumps. To accept the test as done properly, a player had to land appropriately on the platform with the feet (a whole foot had to be on the proper side of the platform). The maximum values were measured during the test:

- reaction of the ground (kg)
- maximum strength
- maximum power
- the height of the gravity centre location

To assess the relations among particular values, the Pearson correlation test was used. Maximum, minimum and average values were also determined as well as their deviations.

Results

Table 1. presents the results of the CMJ jump test including the maximum value of the lower limbs load (kg), strength, power and body weight of the men examined. The results indicate that the group varied in terms of the body weight, the right limb was the dominating one during the bounce in the majority of people. There was also a wide range of the results in the maximum values of the lower limbs load, strength and power.

Tab. 1. Men research results – body weight, maximum load of left, right and both limbs, maximum height of the gravity centre location, maximum strength and power.

Men's	Body weight	Maximum load of left limb (kg)	Maximum load of right limb (kg)	Maximum load of right and left limb (kg)	Decrease of the gravity centre (at maximum level of flying phase) (cm)	Strength (N/100)	Maximum power at the bounce (W/100)
Average	72,6	101,15	107,39	208,54	34,54	13,35	19,58
Max	101,7	146,3	188,2	334,5	53,2	24,7	30,4
Min	52,8	52,7	65	125,6	20,2	6,8	8,5
Average deviation	10,13	17,72	21,25	35,02	7,81	2,85	4,77
Standard deviation	12,54	22,84	28,26	46,28	9,27	3,74	5,74

Figures 1. and 2. present a diagram of the left and right limb involvement during the jump in percents. In the examined group, the right limb was more loaded in the 83% of women and 65% of men.

A similar difference was observed in the women's group. Comparing both of the tables, it is concluded that women were significantly less able to develop the maximum strength in the shortest time. Minimum values in the jump height were similar.

Tab. 2. Women research results – body weight, maximum load of left, right and both limbs, maximum height of the gravity centre location, maximum strength and power.

Women's	Body weight	Maximum load of left limb (kg)	Maximum load of right limb (kg)	Maximum load of right and left leg (kg)	Decrease of the gravity centre (at maximum level of flying phase) (cm)	Strength (N/100)	Maximum power at the bounce (W/100)
Average	64,08	90,30	91,54	181,85	30,65	11,53	14,80
Max	82,5	128,7	124,1	252,8	40,6	17,3	23,9
Min	43,4	65,3	60,5	137,3	21,9	6,7	9,9
Average deviation	10,16	13,20	17,42	30,17	4,03	2,52	3,07
Standard deviation	12,29	17,90	21,27	37,82	5,47	3,24	4,11

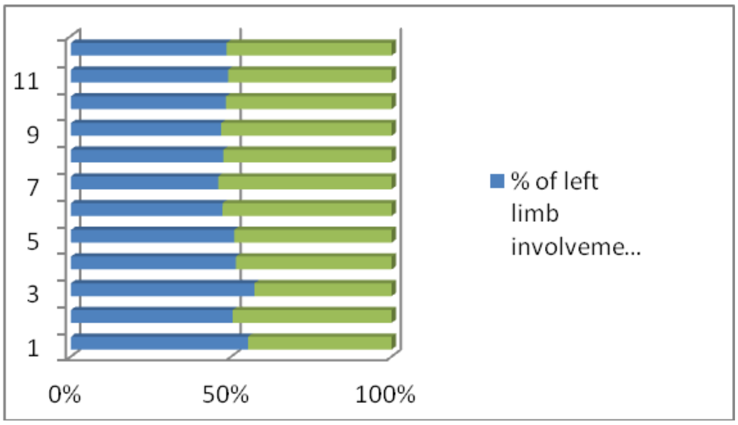

Fig. 1. Percentage of the left and right limb involvement during the jump in the women's group.

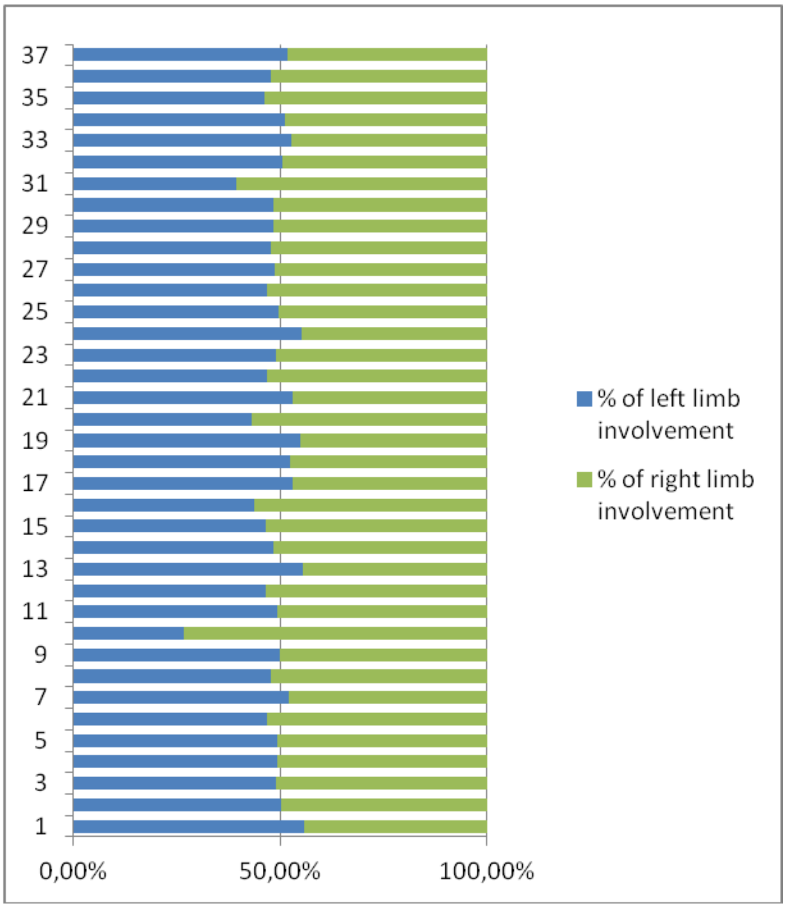

Fig 2. Percentage of the left and right limb involvement during the jump in the men's group.

Tables 3. and 4. present the comparison of the Pearson correlation among the results received. The research results show a strong and statistically significant correlation between the players' power and the maximum height of the gravity centre location during the flying phase.

A strong correlation (in men's group it is statistically significant) is also visible between the body weight and the maximum load of lower limbs at the bounce. The remaining correlations statistically significant indicate that parameters such as maximum power, strength, lower limbs load depend on each other irrespective of being measured in a different moment.

Tab. 3. Pearson correlation coefficient for measured values in the men group for p<0,05.

	Average	Standard deviation	Maximum load of lower right and left limb (kg)	Strength (N/100)	Decrease of the gravity centre (at maximum strength) (cm)	Maximum height of the gravity centre location (cm)	Body weight (kg)	Maximum power at the bounce (W/100)
Maximum load of lower right and left limb (kg)	208,54	46,28	1	0,97	-0,25	0,14	0,71	0,84
Strength (N/100)	13,35	3,74	0,97	1	-0,26	0,12	0,54	0,82
Decrease of the gravity centre (at maximum strength) (cm)	13,72	8,39	-0,25	-0,26	1	-0,02	-0,13	-0,06
Maximum height of the gravity centre location (cm)	34,54	9,27	0,14	0,12	-0,02	1	0,15	0,52
Body weight (kg)	72,6	12,54	0,71	0,54	-0,13	0,15	1	0,63
Maximum power at the bounce (W/100)	19,71	5,72	0,84	0,82	-0,06	0,52	0,63	1

Tab 4. Pearson correlation coefficient for measured values in the women group for p<0,05.

	Average	Standard deviation	Maximum load of lower right and left limb (kg)	Strength (N/100)	Decrease of the gravity centre (at maximum strength) (cm)	Maximum height of the gravity centre location (cm)	Body weight (kg)	Maximum power at the bounce (W/100)
Maximum load of lower right and left limb (kg)	181,85	37,82	1	0,94	-0,24	0,34	0,55	0,92
Strength (N/100)	11,53	3,24	0,94	1	-0,30	0,23	0,26	0,89
Decrease of the gravity centre (at maximum strength) (cm)	11,1	4,91	-0,24	-0,30	1	0,41	0,04	-0,13
Maximum height of the gravity centre location (cm)	30,65	5,47	0,34	0,23	0,41	1	0,43	0,58
Body weight (kg)	64,08	12,29	0,55	0,26	0,04	0,43	1	0,47
Maximum power at the bounce (W/100)	14,8	4,11	0,92	0,89	-0,13	0,58	0,47	1

Figures 3.,4.,5.,6. present a spread graph of relationships between the maximum height of the gravity centre location and the maximum power at the bounce in both men’s and women’s groups as well as between the maximum lower limbs load and measured body weight in both men’s and women’s groups. The graphs depict the variety of the groups and the strong positive correlation.

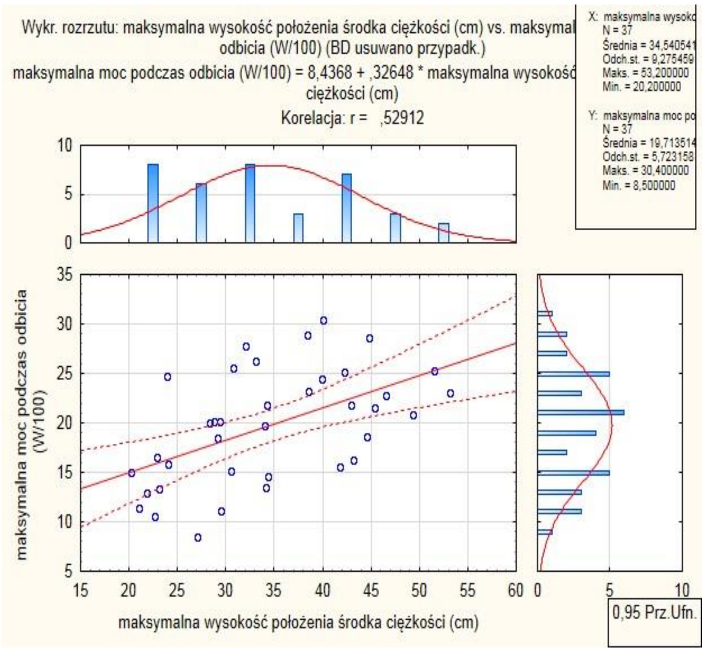

Fig 3. A spread graph of the maximum height of the gravity centre location and the maximum power at the bounce in the men's group.

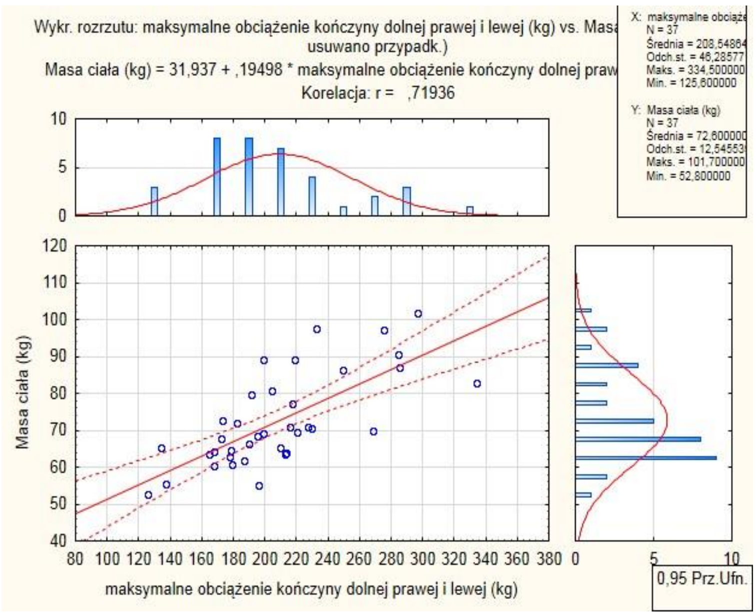

Fig 4. A spread graph of the maximum lower limbs load and the body weight in the men's group.

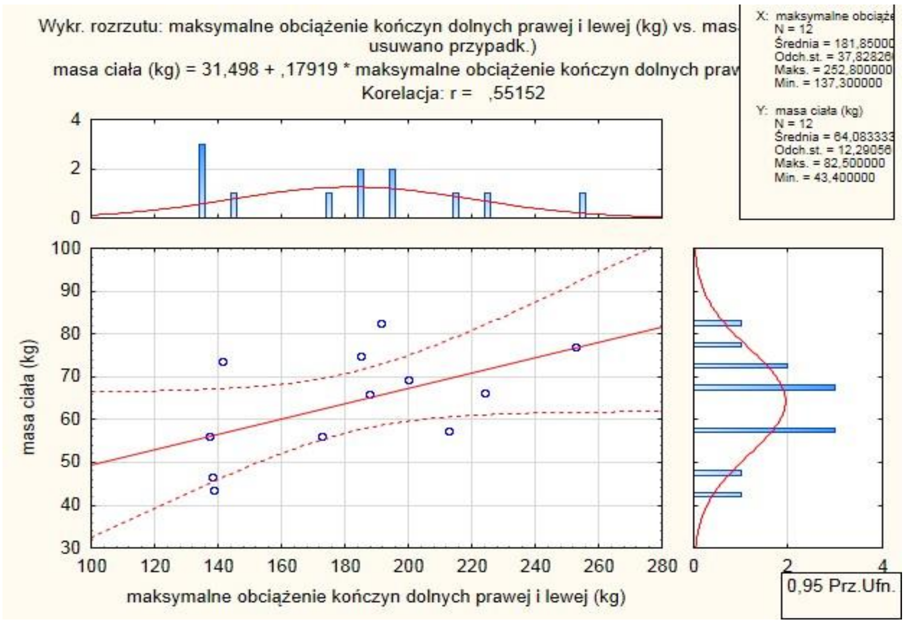

Fig 5. A spread graph of the maximum lower limbs load and the body weight in the women's group.

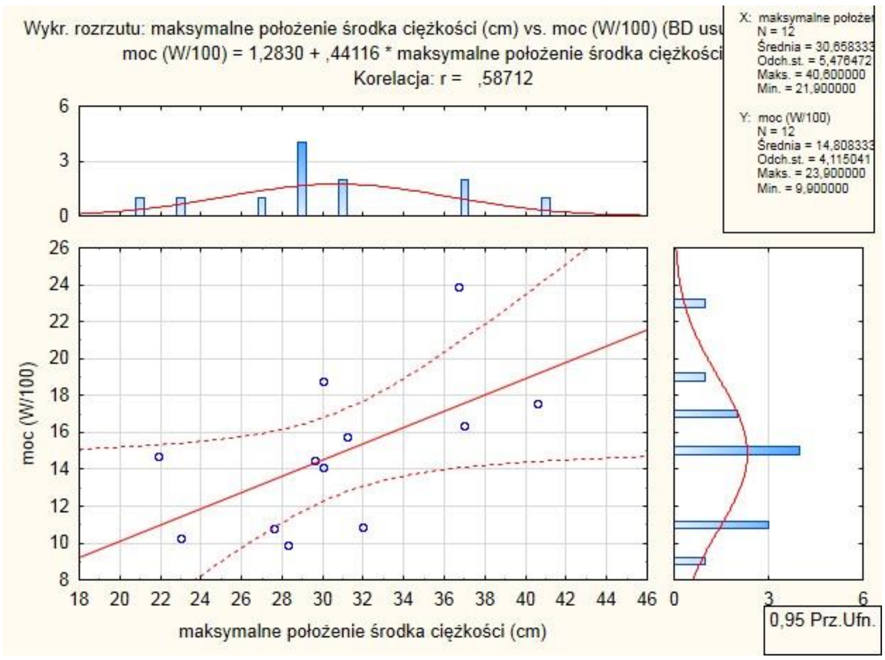

Fig 6. A spread graph of the maximum height of the gravity centre location and the maximum power at the bounce in the women's group.

Discussion

The gathered material indicates strong relationships among the parameters measured on the dynamographic platform, which may suggest its usefulness in the lower limbs explosive strength assessment. The material also showed that the examined male and female groups of players participating in the tournament vary in the scope of the lower limbs strength, which may directly affect the results achieved during the play. However, it should be noted that the research includes only one of the many elements which the motor ability consists of. Comparing the jump height determined on the basis of the gravity centre location with the strength classification according to Trzaskoma and Trzaskoma, the following results would be achieved in the men's group: weak result for 31 players, medium for 3, good for 2 and very good for 1. In the women's group the results would be: weak result for 9 players, medium for 2, good for 1 and very good for no player. The attention should be paid to the fact that the classification was not created on the basis of the gravity centre location, but on the basis of the vertical jump height. Such research is more subjective and may lead the researcher to overrate the result. The standards are also created for mentally healthy people, whereas the Skowroński research clearly demonstrates that mentally disabled people are weaker as far as motor ability is concerned than mentally healthy peers [4,5].

The research included the majority of people with the low level of mental disability. There were no people with the severe level of mental disability. The Skowroński research showed that young people with both low and medium level of mental disability vary in the scope of the motor ability, yet the difference decreases with age. The research also showed that the best people from both groups may achieve similar results. This is caused by the fact that the Polish classification does not include the motor ability of a person in terms of mental disability. Taking this into account as well as the fact that the researched group represented the best players in Poland, it could be stated that the group was similar in terms of the abilities but different in terms of the results [4,5].

Tests used to assess and classify the sport teams as well as the matches observed undoubtedly allow to determine the technical skills of football players. However, it is not possible to fully assess the motor ability of the sportspeople. On the other hand, the motor ability of the participants of both the special Olympics tournament and adult or teenager football matches is different, which was proved in the research of Sępień and associates as well as in the research of Rutowicz and associates [9,10].

The measurement of the explosive strength with the use of the dynamographic platform seems to be a proper and objective way of assessing one of the motor features. Among other available tests, this way of assessing is deprived of the possibility to make a mistake:

- in a case of determining the vertical jump height: shoulder blade movement or body extension on the side of the extending hand, overrating or underrating the result by the researcher

- tests in which the time in the air is measured: bending legs at landing significantly influences the result

The implemented research indicate the similar positive correlation between the player's maximum power at the bounce and the jump height just like in the Gajewski and Wit research [11].

Conclusions

1.The research results indicated strong and statistically significant correlation between participants' power and the maximum height of the gravity centre location during the flight phase.

2. A strong correlation (statistically significant in the men's group) is also visible between the body weight and the maximum load of lower limbs at the bounce.

3. The remaining statistically significant relationships indicate that such parameters as maximum power, strength, lower limbs load depend on each other irrespective of being measured in a different moment.

4. The researched group presented large differences, both morphological and those concerning the parameter of the lower limbs explosive strength.

5. Explosive power assessment on the dynamographic platform requires a good preparation from the researchers. A fact that 14% of people did not perform the test properly suggests to pay attention to the following errors noticed in the research:

- lack of the motivation,
- incorrect landing after the jump (a leg out of the platform, both legs on one platform).

References

1. Trzaskoma Z, Trzaskoma Ł. Kompleksowe zwiększanie siły mięśniowej sportowców. Warszawa, Biblioteka Trenera, 2001.
2. Bober T, Rutkowska-Kucharska A, Pietraszewska B. Ćwiczenia plyometryczne – charakterystyka biomechaniczna, wskaźniki, zastosowania. Sport Wyczynowy, 2007, 7-9, p.5-23
3. Cometti G. La preparation physique en football. Chiron, 2002.
4. Skowroński In: Sprawność motoryczna, budowa somatyczna osób z lekkim, umiarkowanym oraz znacznym upośledzeniem umysłowym w wieku od 10,5 do 17,5 lat. AWF Warszawa, 2003.
5. Skowroński W. Sprawność motoryczna osób niepełnosprawnych intelektualnie w 1993 i 2004 roku w Polsce. AWF Warszawa 2006.
6. Robertson S, Frost H, Doll H, O'Connor J. Leg extensor power and quadriceps strength: an assessment of repeatability in patients with osteoarthritic knees. Clin Rehabil. 1998, 12(2), p.120-126
7. Migasiewicz J. Znaczenie siły mięśniowej dla sprawności motorycznej dzieci i młodzieży w wieku 7-15 lat. Rozprawy naukowe AWF we Wrocławiu, 1991 .
8. Mynarski W. Struktura wewnętrzna zdolności motorycznych dzieci i młodzieży w wieku 8-18 lat w: AWF Katowice, 1996.
9. Rutowicz B, Lipecki K, Bednarski L.: Porównanie poziomu wybranych zdolności motorycznych oraz cech morfologiczno-strukturalnych u wysoko kwalifikowanych 14 i 15 letnich piłkarzy nożnych. In: Nabór i selekcja oraz szkolenie dzieci i młodzieży w zakresie sportowych gier z piłką. Żak S, Klocka T. Wrocław, 2003.
10. Stępień P, Radzimiński Ł, Jaskulska E, Jastrzębski Z. Związki korelacyjne pomiędzy wytrzymałością, szybkością i siłą u piłkarzy

nożnych Kadry Narodowej U-15. In: Jastrzębski Z, (ed.).Teoria i praktyka wychowania fizycznego i sportu. T. 2 Łódź, Wyższa Szkoła Sportowa, 2012.

11. Gajewski J, Wit A. The influence of selected body dimensional variables on the mechanical parameters of the vertical jump. In: Riehle H,. Vieten M. Proceeding I of the XVI ISBS Symposum. Universitatsverlag Konstanz GmbH, Germany, 1998 p. 105-108.
12. Przepisy sportowe, piłka nożna Olimpiad Specjalnych http://www.olimpiadyspecjalne.pl/sites/default/files/dyscypliny/pliki/pilka_nozna_0.pdf (access: 2013.11.04).