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Original empirical article

THE DISPROPORTION OF THE DOMINANT AND ANCILLARY EXTREMITIES IN DISPLAYING MOVEMENT FREQUENCY AMONG YOUNG BASKETBALL PLAYERS

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Abstract. *Disproportion is an omnipresent occurrence typical for both man and the natural world. Everything that is not identical on both sides of its axis can be considered disproportionate. Basketball is comprised of the following activities: running, jumping, changes of direction, abrupt stops, dribbling, passes, shooting, etc. All of the mentioned activities represent an essential part of the game but with all of them there is a tendency towards the disproportionate use of the extremities, so the left and the right sides of the body are employed differently. The aim of this research was to determine mutual disproportion, which occurs as the consequence of the quality of life and the sport the examinees play. One of the key things was finding out all the possible differences among the three age categories, that is, among the relevant variables and the extent to which they are manifested. A total of 64 young basketball players took part in the research. They were divided into three age groups according to the propositions of the Serbian Basketball Association. The set of measuring instruments comes from the anthropometric (body height - AVIS and body mass - AMAS) and the motor (leg movement frequency, dominant and ancillary - TAPND and TAPNN and hand movement frequency, dominant and ancillary - TAPRD and TAPRN) space and the participants had to fill in a questionnaire, the function of which was to determine their dominant extremity on the grounds of the answers given. A formula for calculating the disproportion coefficient (Jatrjembskaia & Titov, 1999) was used in this research for all the measured variables related to the extremities. The formula is as follows: $AS=D-ND/D\times100$. Along with the given formula which was used for determining the mutual relationship between the dominant and ancillary parts of the body, another formula which unified all the relevant variables was used: $AS(n)=\Sigma AS/n$. The methods used from the field of comparative statistics were: the T–test and the variance analysis (ANOVA), and in the post-hoc analysis the Tukey test was used. The results show the anticipated differences in the movement frequency of the dominant upper and lower extremities.*

Key words: *disproportion, extremities, movement frequency, young basketball players.*

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1. INTRODUCTION

Disproportion is an omnipresent occurrence typical for both man and the natural world. Everything that is not identical on both sides of its axis can be considered disproportionate. There are a lot of things that influence the development of such an occurrence and it is a great challenge to conduct research into the functional disproportion among people, which in turn refers to making certain movements with the help of sensory organs and extremities. The research within the scope of this work should, in an empirical way, provide information on the disproportionate use of extremities in basketball and the frequency of movement occurrence among young basketball players.

Basketball is a collective sport comprised of the following activities: running, jumping, changes of direction, abrupt stops, dribbling, passes, shooting, etc. All of the mentioned activities represent an essential part of the game but with all of them there is a tendency towards the disproportionate use of the extremities, so that the left and the right sides of the body are employed differently.

The disproportion of the body offers the best explanation for the mutual connection between morphological and functional space since the domination of one brain hemisphere, in most cases the left one, causes disproportion in the functioning of the extremities so the right side is, in the majority of cases, more dominant. Such functional disproportion causes, in turn, morphological disproportion, which has been proved by a great number of studies. Some of the most significant ones deal with the way body disproportion differs among people of different vocations.

The brain is the only organ which exhibits functional disproportion or lateral functioning. Each brain hemisphere was once thought to perform certain functions. Such a concept has now been abandoned, so nowadays it is believed that both hemispheres take part in performance, with one hemisphere being dominant for certain functions or different aspects of the same function.

Functional disproportion of the hemispheres can be observed when visual, auditory, verbal, emotional (both verbal and non-verbal), olfactive, tactile and nociceptive information is being processed.

It is crucial that left-handed young basketball players receive special treatment during puberty. Scientific studies have proven that left-handed athletes are more successful than the right-handed ones in various disciplines. Some famous left-handed players such as R. Korać, T. Kukoč and Ž. Paspalj had a distinctive style of playing which was most conspicuous when they played offense. The demand on a left-handed player to use his ancillary right is more moderate than when it comes to the technical preparation of right-handed players because left-handed players do not only have a disproportion in mobility but they also have different manipulative abilities (such as the control of the ball).

The subject matter of this research was made up of the different aspects of displaying movement frequency of the extremities among young male players aged 11 to 18, who have undergone different levels of basketball training. The aim of this research was to determine the mutual disproportion, which occurs as the consequence of the quality of life and the sport they play. One of the key things was finding out all the possible differences among the three age categories, that is, among the relevant variables.

2. METHODOLOGY

2.1 The sample of participants

The participants were the boys who play basketball for the basketball club KK SPORT EKO, Belgrade. When the players are young, the main motive for playing the sport is exclusively the desire for the game, whereas with older players there is a type of selection. The number of children influences the quality of group formation. A total of 64 young basketball players took part in this study (with the average age of 15.05±1.64, average height of 173.41±11.81cm and average weight of 62.71±13.09 kg) divided into three groups depending on their age. According to the rules of the Serbian Basketball Association, three categories could be formed: the pioneers – 28 participants (aged 13.43 ± 0.50, 165.05 ± 10.20 cm and 55.27 ± 11.32 kg), cadets – 21 participants (aged 15.62 ± 0.50, 177.02 ± 8.27 cm and 63.83 ± 8.93 kg) and juniors -15 participants (aged 17.26 ± 0.46, 183. 95 ± 7.14 cm and 75.03 ± 11.61 kg).

2.2 The set of measuring instruments

The set of measuring instruments comes from anthropometric and motor space, and when it comes to the place of testing the type is combined. This means that certain variables were tested out in the field whereas some other variables were tested in the controlled conditions of the laboratory. Apart from the previously mentioned set of measuring instruments from anthropometric and the motor space, the participants had to fill in a questionnaire, the function of which was to determine the dominant extremity on the grounds of the answers given. The questionnaire consisted of the following questions: (related to determining the more dominant hand) which hand was used for writing, which one was used for shooting and with which hand were their passes more efficient; (related to determining the more dominant leg) which leg they used when shooting, which one they used as the takeoff point and which one that the participants first placed on the stairs. The more dominant extremity is the one mentioned in at least two answers. The set of measuring instruments for evaluating the anthropometric characteristics of the participants was: body height (AVIS) and body mass (AMAS). The standardized measuring instruments (GPM, Switzerland) were used for measuring the anthropometric characteristics. The measuring was done following the international procedure (Eston & Reilly, 2005; ACSM, 2006). The results were read, including the tenth part of the measuring unit. The gathered data was subjected to a statistical analysis. They will be used as the identification of the height and the mass of the participants that took part in the research. The set of measuring instruments for evaluating motor characteristics of the participants included: the frequency of leg movements (dominant and ancillary) (TAPND) and (TAPNN) and the frequency of hand movements (dominant and ancillary) (TAPRD) and (TAPRN).

2.3 Data processing methodology

The following statistic methods were used for processing the collected data: descriptive statistics: the arithmetic mean (*mean*), minimum (*minimum*) and maximum (*maximum*) values and standard deviation (*std deviation*) of all the measured variables.

Apart from the mentioned standard statistic methods used in the data presentation and analysis, a formula for calculating the disproportion coefficient (Jatrjembskaia & Titov,

1999) was used in this research for all the measured variables related to the extremities. The formula is as follows: AS=D-ND/D×100. AS stands for the disproportion coefficient, D for the dominant and ND for the ancillary side.

Along with the given formula which was used for determining the mutual relationship between the dominant and ancillary parts of the body, another formula which unified all the relevant variables was used: AS(n)=ΣAS/n, with n representing the number of analyzed variables or elements analyzed by the disproportion coefficient. Any results above 5% were considered significant. The methods used from the field of comparative statistics were: the T–test and the variance analysis (ANOVA), and in the *post-hoc* analysis, the Tukey test was used.

3. THE RESULTS OF THE RESEARCH WITH THE DISCUSSION

Table 1. The movement frequency of dominant and ancillary parts of the participants divided into groups

MI/GROUP	N	Min.	Max.	Mean	SD
TAPND-P	28	8.68	12.3	9.932	1.04189
TAPNN-P	28	8.66	13.4	10.52	1.14564
TAPND-K	21	7.43	12.2	9.289	1.11425
TAPNN-K	21	8.08	13	10.17	1.10423
TAPND-J	15	7.97	10.2	9.112	0.68511
TAPNN-J	15	7.73	10.5	9.353	0.77985

Table 2. The values of all the measuring instruments for evaluating movement frequency for all the participants

MI	N	Min.	Max.	Mean	SD
TAPRD	64	4.6	7.67	5.9108	0.6552
TAPRN	64	4.48	10.4	6.658	0.9375
TAPND	64	7.43	12.3	9.5288	1.0472
TAPNN	64	7.73	13.4	10.129	1.138

There is also the anticipated difference in the movement frequency of the dominant upper extremity. The movement frequency of the upper extremities shows the statistic significance for all the participants, and for all the groups.

Table 3. The disproportion coefficient of the following measuring instruments: hand movement frequency (TAPR/ AS) and leg movement frequency (TAPN/ AS) for all the participants (TOTAL/ AS) and for all the groups (PIO/ AS, KAD/ AS and JUN/AS)

	TOTAL/AS	PIO/AS	KAD/AS	JUN/AS
TAPR/AS	12.79*	13.14*	13.60*	11.00*
TAPN/AS	6.54*	6.17*	9.76*	2.7

The results show the anticipated differences in the movement frequency of the dominant lower extremity. The movement frequency of the lower extremities shows statistic significance for all the participants, and for all the groups, with the exception of the junior group.

Table 4. The T-test (two-way) for the dependent measuring instruments, of the participants in groups

GROUPS	VARIABLES	t	df	Sig. (2-tailed)
PIONEERS	TAPRD - TAPRN	-6.249	27	.000*
PIONEERS	TAPND - TAPNN	-3.568	27	.001*
CADETS	TAPRD - TAPRN	-7.430	20	.000*
CADETS	TAPND - TAPNN	-7.577	20	.000*
JUNIORS	TAPRD - TAPRN	-2.813	14	.014*
JUNIORS	TAPND - TAPNN	-1.985	14	.067

Table 5. T-test,(two-way) for the dependent variables (the motor variables) for all the participants

TOTAL	t	df	Sig. (2-tailed)
TAPRD - TAPRN	-9.218	63	.000*
TAPND - TAPNN	-6.683	63	.000*

The T-test results show a statistically significant difference in the movement frequency with t = -6.683. In the case of the groups, there is a statistically significant difference in the PIONEER group with t = -3.568 and in the CADET group with t = -7.577. As far as the JUNIOR group is concerned, no statistically significant difference was detected. As with the hand movement frequency, this test was also conducted in the time function, so the negative t values are in favor of the dominant extremity.

The T-test for all the participants is t = -9.218 and for the groups: PIONEERS t = -6.249, CADETS t = -7.430 and JUNIORS t = -2.813. The results of the T –test are negative, but in this case it does not mean that the dominant extremity is weaker, but quite contrary. It is due to the fact that the tapping test is inversely proportional to the time so the lower the value, the better the result.

Table 6. The ANOVA for the motor variables of the groups in relation to the age group the participants belong to

		Square sum	df	Mean	F	Sig.
TAPRD	Between groups	10.761	2	5.381	20.155	.000
	Within groups	16.285	61	.267		
	Total	27.046	63			
TAPRN	Between groups	17.166	2	8.583	13.705	.000
	Within groups	38.202	61	.626		
	Total	55.368	63			
TAPND	Between groups	8.373	2	4.186	4.206	.019
	Within groups	60.712	61	.995		
	Total	69.085	63			
TAPNN	Between groups	13.246	2	6.623	5.912	.005
	Within groups	68.338	61	1.120		
	Total	81.584	63			

Table 7. The Tukey test for the hand tapping variables (ancillary) (TAPRN) and for the leg tapping variable (dominant) (TAPND) and (ancillary) (TAPNN)
Tukey HSD

Age	N	1	2	1	2	1	2
Juniors	15	5.81		9.112		9.353	
Cadets	21		6.632	9.289	9.289		10.17
Pioneers	28		7.133		9.932		10.52
Sig.		1	0.12	0.842	0.111	1	0.559

The Tukey test shows that there is homogeneity of the results in the PIONEER and CADET groups. It also shows homogeneity of the dominant leg movement frequency in the CADET and JUNIOR groups. There is homogeneity of the ancillary leg movement frequency in the CADET and PIONEER groups.

The research shows that there is a statistically significant difference in hand movement frequency, to the advantage of the dominant extremity, which is clearly the consequence of the training process, that is, the unequal usage of the upper extremities during not just the training process, but all the activities in everyday life. The Tukey test showed homogeneity of the ancillary hand movement frequency results between the PIONEER and CADET groups. It is important to say that disproportion has the tendency of declining in relation to the age of the participants. This means that disproportion is lower among the older participants, which agrees with the research conducted by Stöckel and Weigelt (2007), though these data should be considered with reservation and should be the subject of a wider-scale study with a bigger number of participants and a more balanced number of participants in the age groups. The reason for the declining tendency could also lie in the fact that a long-term training process stabilizes the motor stereotype, that is, that the dominant extremity reaches a certain level of development, whereas there is still enough room for the ancillary extremity to progress. That decreases the difference in the disproportion.

A good starting point could be the research carried out by Demure et al. (2006) which refers to the relation of the disproportionate use of extremities between the sexes. For the purpose of improving the specific training process, the focal point should be the difference between the players' positions in the team (Vičić and Dežman, 1999) expanded to the field of disproportionate realization of certain movements in basketball, with the aim of reducing disproportion as much as possible.

4. CONCLUSION

The research presented in this work shows that there is a certain level of disproportion in certain variables and in the case of all the participants. It appears to be the consequence of not just common everyday activities but also the training process and the unequal use of the extremities. The fact is that we live in a right-oriented world so it is very difficult to achieve equal use of one's extremities. When it comes to sports, in this case basketball, there is more room for achieving equality of extremity use. This fact should not hinder but motivate research into new methods for reducing disproportion to an acceptable degree.

Future research should be conducted with a larger number of participants, follow them through different phases of their biological development and resulting in successful methods for reducing disproportion. It would be a good thing if the best methods for the research into disproportion and its tracking could be defined. Then certain standards of testing in sports could be set.

Reducing disproportion is the task of sports experts who should learn more about the problem and apply the gained knowledge to working with athletes. The experts who work with beginners should have the biggest influence in this matter. The most common mistake is deliberately forcing the use of dominant extremities when a new movement is being taught. It just causes further damage to the already disturbed proportion. The opposite process could have a better transfer on bilateral balance.

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ASIMETRIJA DOMINANTNIH I NEDOMINANTNIH EKSTREMITETA U ISPOLJAVANJU FREKVENCIJE POKRETA KOD MLADIH KOŠARKAŠA

Aleksandar Čvorović, Miodrag Kocić, Dragana Berić

Asimetrija je pojava koja je prisutna u našem okruženju i svojstvena je ne samo čoveku, već se javlja u čitavom živom svetu. Sve što nije identično sa obe strane ose može se smatrati asimetričnim. Kod aktivnosti trčanja, skoakanja, naglih promena pravca kretanja, driblinga, šutiranja, koji predstavljaju sastavni deo košarkaške igre, javlja se tendencija da se ekstremiteti ne koriste uvek proporcionalno i u istoj meri, pa imamo razliku u angažovanosti leve i desne strane tela. Cilj istraživanja je utvrđivanje međusobne asimetrije koja se javlja kao posledica načina života i specifičnosti sportske igre kojom se ispitanici bave, te da se utvrde eventualne razlike u odnosu na tri različite uzrasne kategorije, odnosno da li postoje međusobne razlike među grupama u pogledu svih ispitivanih varijabli i u kojoj meri su izražene. Uzorak ispitanika čine 64 dečaka, mladih košarkaša, raspoređenih u tri grupe na osnovu starosti, odnosno uzrasne kategorije kojoj pripadaju na osnovu

propozicija KSS. Uzorak mernih instrumenata je iz antropometrijskog (visina tela-AVIS i masa tela-AMAS) i motoričkog prostora (frekvencija pokreta noge, dominantna i nedominantna–TAPND i TAPNN i frekvencija pokreta ruke, dominantna i nedominantna–TAPRD i TAPRN), a ispitanici su popunjavali i upitnik koji se tiče utvrđivanja dominantnog ekstremiteta, a utvrdjuje se na osnovu dobijenih odgovora. Za prezentaciju i analizu podataka u ovom istraživanju je korištena formula za izračunavanje koeficijenta asimetrije (Jatrjembskaia & Titov 1999;) za sve merene varijable koje se odnose na ekstremitete, a ona je sledeća: $AS = D - ND / D \times 100$. Osim navedene formule koja utvrđuje međusobni odnos dominantnog i nedominantnog dela tela, upotrebljena je i formula koja objedinjuje sve varijable koje su opservirane a glasi: $AS(n) = \Sigma AS / n$. Iz oblasti komparativne statistike: T- test i analiza varijanse (ANOVA), a za post-hoc analizu korišten je Takijev test (Tukey). Dobijene su očekivane razlike u frekvenciji pokreta kod dominantnog donjeg i gornjeg ekstremiteta.

Ključne reči: *asimetrija, ekstremiteti, frekvencija pokreta, mladi košarkaši.*