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## Comparison of Albanian female volleyball player with anthropometric, performance and haematological parameters


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### ABSTRACT

Bozo D, Lleshi E. Comparison of Albanian female volleyball player with anthropometric, performance and haematological parameters. *J. Hum. Sport Exerc.* Vol. 7, No. Proc1, pp. S41-S50, 2012. The purpose of this study was to investigate and compare, on a set of basic anthropometric characteristics, specific volleyball performance indicators and a number of haematological parameters, between elite and nonelite female volleyball players in Albania. A total of 39 subjects were assessed and analyzed for three sets of indicators: 5 anthropometric characteristics (BH, BW, BMI, %BF, and %LBM), 3 performance tests (Jump with one hand, Jump with two hands, Height of the Arm) and 11 haematological markers (WBC, Lymph, Mid, Gran, Hgb, RBC, Hct, MCV, MCH, MCHC, ERC). The obtained results show that physical parameters such as body height, height of the arm, body weight, %BF display generally better values in elite teams but special abilities could be found and appreciated also in a local team, although with less better starting anthropometric and physical characteristics. The physical parameters are collinearly correlated to jump performance tests in both teams but with better values in the local team, different from the expectations. Haematological profiling does not show evident differences between the team groups; however these markers signal for eventual health or performance related alterations especially those related to anemia, which is a predictable and expectable health problem for this gender and age group. The above parameters, alone and in combination with each other, would allow coaches and athletes to identify and assess the physical and performance characteristics specific to the age groups for purposes of professional evaluation, selection, monitoring and continuous development at both individual and team level. **Key words:** PERFORMANCE PARAMETERS, PERCENT BODY FAT, NATIONAL AND LOCAL FEMALE VOLLEYBALL TEAMS, HAEMATOLOGIC PROFILING.

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## INTRODUCTION

Anthropometric characteristics and morphological parameters are extremely important indicators in determining the success of an athlete (Cometti, 2009; Wilmore, 1999). These characteristics, in combination with the physiological and biochemical tests are becoming more and more subject of diverse studies especially in the last two decades (Hartmann, 2000).

It is already known that anthropometric parameters, performance and haematological indicators are specific in different sports and markedly depend from heredity, age, individual development pattern and gender, and exercise practice as well (Hartmann et al., 2002). They can be used on one side, to assess the physical growth and nutritional status of sport exercisers and on the other hand as a reliable individual specific profile for the prediction and improvement of the physical performance. An appropriate and wise use of these indicators and tests, both in quantitative and qualitative terms, a reliable interpretation and integration of the relative values alone or in combination, can be utilized to project the performance level of the elite sportpersons. The ongoing monitoring of such parameters, the identification of eventual health and/or performative problems on the other side, can help not only for the healthy maintenance of the sportpersons, but at the same time for planning and undertaking of the proper measures for the continuous improvement of the physical fitness, performance and physiological profile both at individual and group/team level (Claessens et al., 1999).

Individuals respond and adapt to different exercise levels and types in different and through various biological, biochemical and physiological mechanism and ways, depending on various factors such as age, gender, development phase, physiological status and others. But it seems that exercise and sport training and level seem to be among the most important influencing factors (Fleck et al., 1985). Exercise induces stress on the body and brings about a number of blood cells alterations and related blood parameters (Petibois et al., 2003). Alterations of haematological parameters by their side can influence differently the physical and sport performance in different types of sport (Descorges, 2008). The response patterns can show the appropriateness of the exercising and training to different individuals, to the age and gender and the stress level if any. Being the biochemical markers quicker than the physical changes, showing strong correlation with the overall health status, the physical and sport performance, they can be used to rapidly check and follow eventual health or training problems that can arise or experience different sportpersons particularly during nonpersonalized training programs (Withold et al., 2011).

Volleyball is a specialized sport, distinguishable through specific anthropometric, physical and performance parameters and tests, but distinctive at different competition levels as well (Duncan et al., 2006). The study of such parameters, the relationship and correlations between anthropometric and physiological parameters of volleyball players, have been object of several studies (Duncan et al., 2006; Gladden, 1978; Case et al., 1985; Fry et al., 1991). They show that a number of anthropometric and physical characteristics (Body Height, Body Weight, %Body Fat,) and physical-performance parameters seem to be advantageous to the volleyball players and positively correlated with higher performance (Gladden, 1978; Spence et al., 1980; Case et al., 1985; Shyamal et al., 2010). But despite the popularity of this sport worldwide, there are gaps or poor data on players profiles, particularly those related to adolescent and young female competitors of different ages (Duncan et al., 2006). It is also well known, that young-aged females go against rapid and visible physical, physiological and hormonal changes and these factors highly influence their sport performance along this quick developing period, becoming at the same time causes for health problems such as anemia and other abnormalities (Tsunawake et al., 2003).

In this context, the aim of our study was to carry out a first investigation on anthropometric characteristics, performance abilities and general haematological parameters of young female volleyball players belonging to elite and nonelite, local and university teams. A general anthropometric, performance and haematological profiling was designed, comparison and differences between the elite players against the two other groups were assessed and analysed. It is important to underline, that this is the first study where physical, performance tests and blood markers and comparisons within age-groups become part of an integrative and profiling study in young female volleyball players in Albania.

## MATERIAL AND METHODS

The participants in this study were 39 subjects in total: 24 elite female volleyball players (12 from the Junior National Volleyball Team and 12 from the Youth National Volleyball Team), 8 from a local team from the North of Albania (Rrëshen) and 7 from an university team ("M. Barleti" University). The age range of the elite players was from 15-19, of the local team from 20 to 25, and of the university team from 17-23 years old. The 39 females, subjects of this study, were assessed for 5 anthropometric parameters, 3 specific performance tests and 11 blood markers.

The assessed anthropometric variables were: Body Height (BH), Body Weight (BW), the Body Mass Index (BMI). The Percent Body Fat (%BF) and Percent Lean Body Mass (%LBM) for each subject was calculated based on the individual value of the relative BMI.

Body height was measured during inspiration with a traditional stadiometer to the nearest 0.1-0.2 cm and Body Weight was measured with a digital standing scale approximated to the nearest 100 g. The Body Mass Index (BMI) was calculated as the rate between the Body Weight value and Body Surface BW/BS, where BS = BH<sup>2</sup>, or BMI = BW/BH<sup>2</sup>.

For the calculation of the Percent Body Fat was used the method according to Deurenberg et al. (1991), confirmed for its reliability also from other authors (Jackson, Stanforth, Gagnon et al., 2002). According to the above, the formula used to predict the Body Fat Percentage is calculated taking into account the current individual BMI value, age and gender (Deurenberg et al., 1991).

In its appropriate corrected form for adult females this formula is as the follows:

$$\text{Adult Body Fat\%} = (1.20 \times \text{BMI}) - 0.23 \times \text{age} - 5.4$$

The Percent Lean Body Mass was calculated as the difference from 100 of the individual relative %BF value (Shyamal et al., 2010).

3 specific volleyball performance tests were performed and assessed:

Vertical Jump with one hand at highest reach (a specific attack volleyball test); Vertical Jump with two hands at highest reach (specific block volleyball test) and a physical-performance parameter, height of the arm. Different studies have shown that these specific parameters correlate positively with the general performance in a team and are also related to the particular role of each player in the volleyball team (Cometti et al., 1999).

Anthropometric parameters and performance tests were performed indoor, in normal temperature and pressure conditions, at the premises of the National Sport Palace in Tirana. The blood was taken and analyzed at the Laboratory of Sport & Exercise Biochemistry at Tirana University of Sport. The tests and analysis were performed on full consent of the participants and the relative team coaches.

Hematological profiling was performed through analysis of 11 generic blood markers: White Blood Cells-WBC, Lymphocyte count-Lymph, Mid Sized Cell %-Mid (Basophiles, Eosinophils and Monocytes), Granulocytes-Gran, Red Blood Cells-Rbc, Haemoglobin Concentration-Hgb, Haematocrit-Hct, Mean Corpuscular (erythrocyte) Volume-MCV, Mean Cell (erythrocyte) Hemoglobin-MCH, Mean Cell (erythrocyte) Hemoglobin Concentration-MCHC and Red Cell Sedimentation Time/h-ESR.

Blood sampling took place under standard conditions, in the morning with an empty stomach. The blood from the cubital vein was collected in tubes containing K3EDTA (for 10 cell count parameters) and in parallel tubes containing NaCitrate for the ESR. The above listed variables were analyzed with an Automatic cell counter (Haemoanalyzer "Mindray BC- 3000 Plus) while the ESR using the standard Westergren method.

Standard statistical methods (Mean and Standard Deviation) were used for the direct measures and calculated parameters. One way variance analysis for the comparison of data between the elite, local and university teams was applied. A 5% probability level was determined as statistical significance of differences calculated for each parameter.

## RESULTS

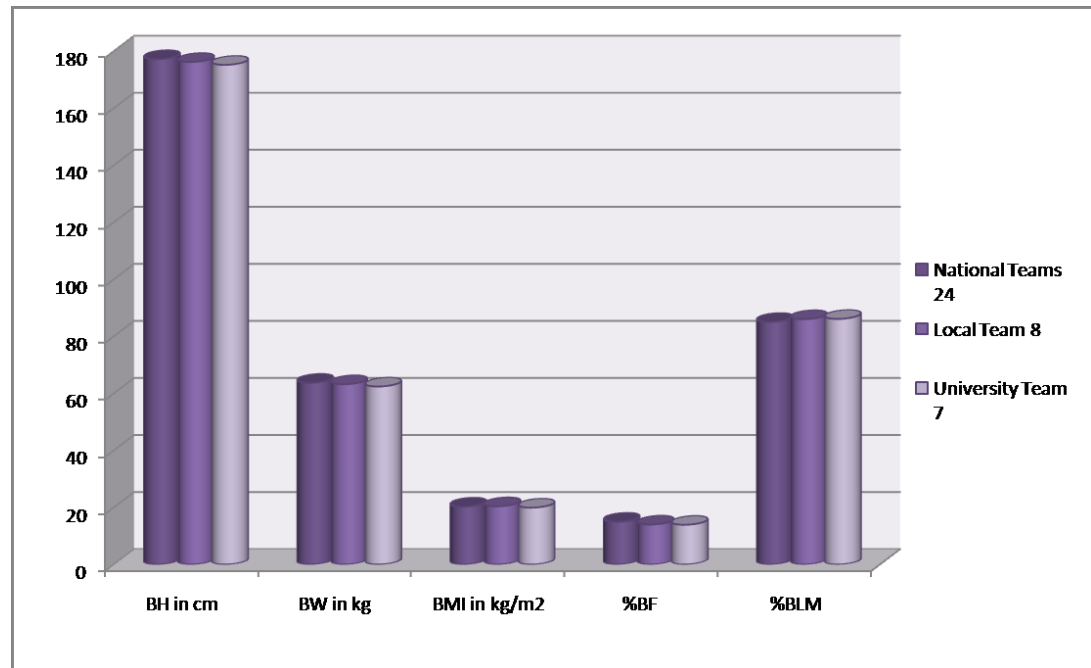
### *Physical and Body Composition Parameters*

The values of both measured and calculated parameters regarding anthropometric and body composition data are given in Table 1 for the three groups under investigation. Each indicator has been reported through the mean team value and the relative standard deviation.

**Table 1.** Values of anthropometric parameters and body composition of Albanian female volleyball teams.

Parameters	National Teams		Local Team		University Team	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Age in years	17.5	1.05	22.1	2.23	20	2.38
Body Height (BH) in cm	177.2	7.61	176.2	5.31	175.2	4.07
Body Weight (BW) in kg	63.7	8.64	63.2	5.54	62.4	9.07
Body Mass Index (BMI) kg/m <sup>2</sup>	20.29	1.57	20.40	2.03	19.92	2.50
Body Fat (BF) in %	14.97	2.00	13.99	2.38	13.91	2.98
Body Lean Mass (BLM) in %	85.03	2.00	86.01	2.38	86.09	2.98

The comparative data for the 5 body parameters in the three teams of the study are shown on the diagram of Figure 1 below.



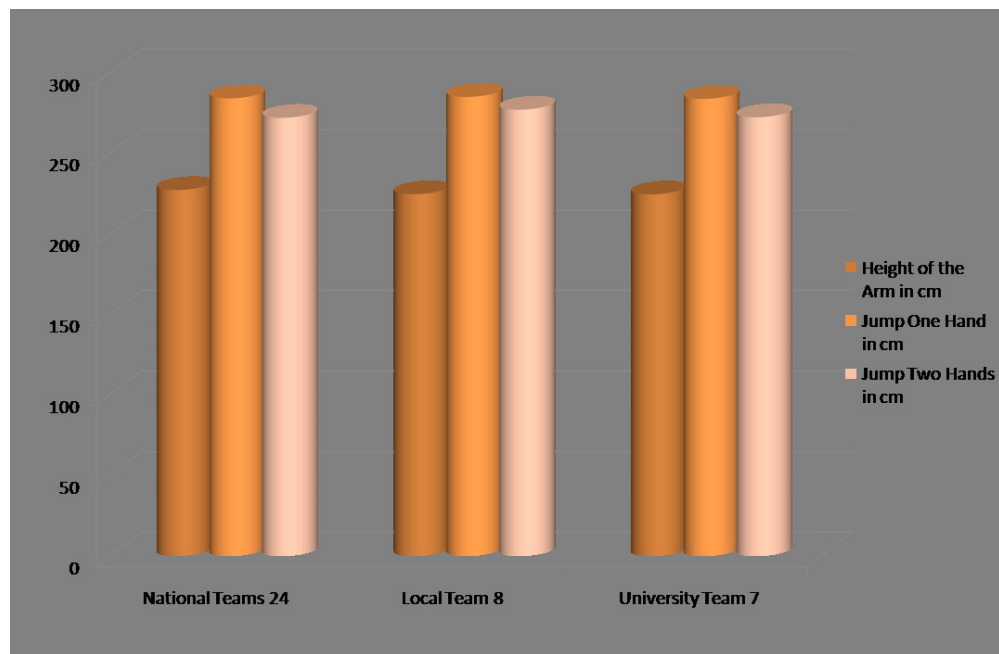
**Figure 1.** Comparison of anthropometric parameters between the national (youth and junior), local and university teams of Albanian female volleyball players.

#### Jump Tests Results

The results of the jump tests for the three teams under study are given in Table 2 and comparatively on the diagram of Figure 2.

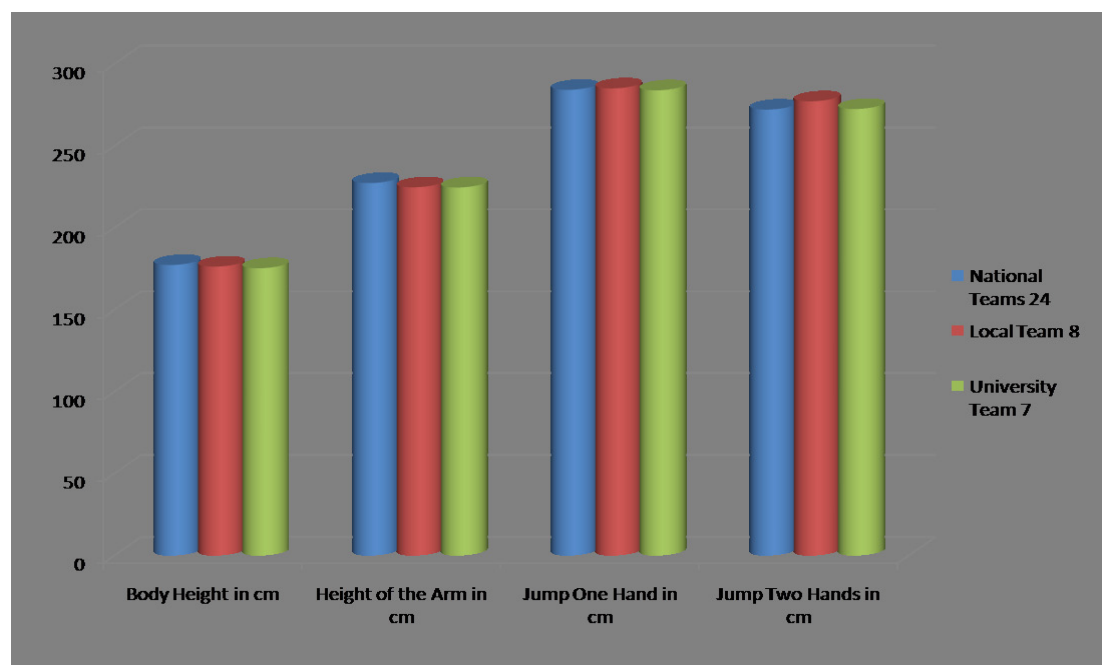
**Table 2.** Values of specific volleyball jump tests of Albanian female volleyball teams.

Parameters	National Teams		Local Team		University Team	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Height of the Arm (HA)+ in cm	227.2	10.32	224.6	7.5	224.5	7.09
Jump with one hand (JOH) + in cm	284.1	10.65	285	9.69	283.8	5.6
Jump with two hands (JTH) + in cm	272.05	12.43	277.1	9.65	272.4	6.9



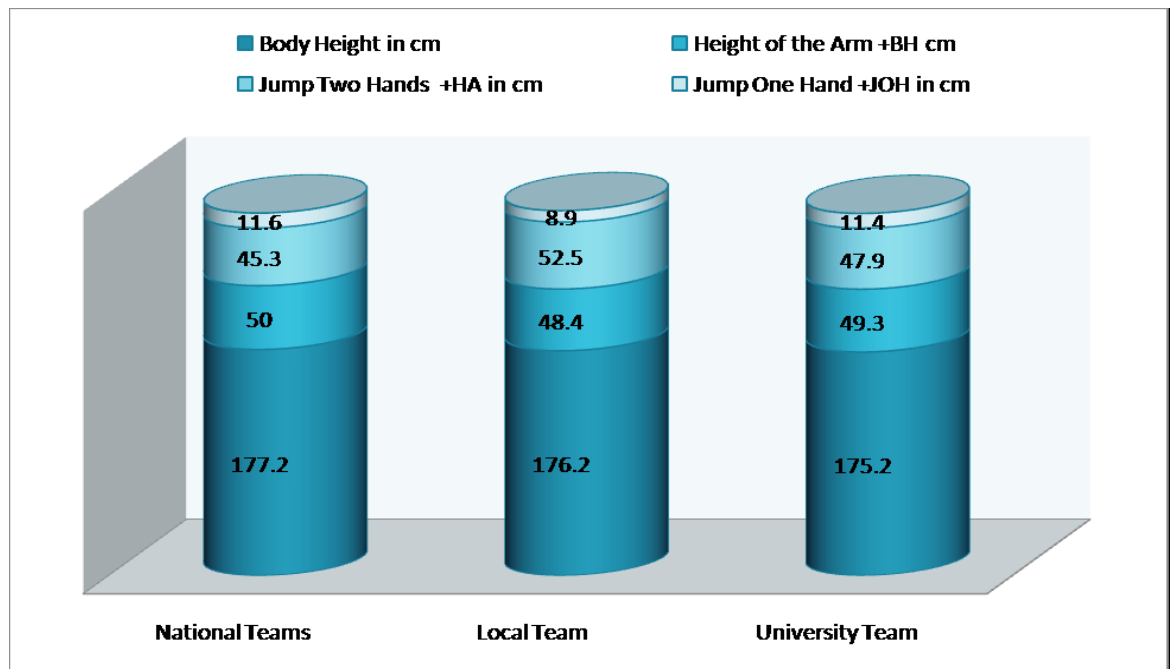
**Figure 2.** Comparison of jump tests data between the national and local and university teams of Albanian female volleyball players.

A comparative analysis between two sets of parameters, physical BH and Height of the Arm and Jump Tests, Jump with one hand and with two hands in the three players teams are presented in Figure 3 below.



**Figure 3.** Comparison between anthropometric and jump parameters between Albanian female volleyball teams.

The comparative data above can be better noticed and distinguished between the groups through the diagram in Figure 4 below.



**Figure 4.** Comparison between anthropometric and relative jump height in Albanian female volleyball teams.

#### Haematological Profiling

The haematological profiling was performed through analysis of 11 blood markers in all 39 individuals under investigation. The data of such parameters in all the three teams which are shown in Table 3 below through the team mean and the relative standard deviation for each parameter.



**Table 3.** Values of blood parameters determined in Albanian female volleyball teams.

	Blood parameters	National Teams		Local Team		University Team		Normal Values
		Mean	SD	Mean	SD	Mean	SD	
1	WBC x10 <sup>9</sup> /L	5.45	1.16	5.02	1.07	5.48	1.49	4.0 - 10.0
2	Lymph x10 <sup>9</sup> /L	1.88	0.34	2.02	0.31	1.98	0.48	0.8 - 4.0
3	MID x 10 <sup>9</sup> /L	0.48	0.14	0.51	0.11	0.42	0.12	0.1 - 0.9
4	Gran x 10 <sup>9</sup> /L)	3.07	0.92	2.48	0.73	3.07	1.11	2.0 - 7.0
5	Hgb g/L	118.72	11.86	116.5	11.23	122.28	13.12	110 - 150
6	RBC x 10 <sup>12</sup> /L	4.23	0.19	4.31	0.34	4.38	0.38	3.50 - 5.00
7	Hct %	36.27	2.61	35.71	2.87	37.22	3.37	37.0 - 48.0
8	MCV fL	85.80	6.58	83.57	10.15	87.65	5.66	82.0 - 95.0
9	MCH pg	27.98	2.93	27.21	3.89	27.81	2.04	27.0 - 31.0
10	MCHC g/L	326.22	11.33	325.5	10.63	327.28	10.02	320 - 360
11	ERS mm/h	14.82	7.70	19.62	8.99	6.14	2.34	< 20

## DISCUSSION AND CONCLUSIONS

The comparison of the data, relative to anthropometric parameters in the three teams displays a heterogeneous scenario and different from the expectations. The volleyball players of the National Youth and Junior Team display values which are better than the local and university team players, for only 1 or 2 parameters out of 5 in total: an insignificant higher Body Height (0.5% and 1.1% respectively against local and university teams), a BMI value lower than the local team (0.5%) but higher than the university team (1.9%), a surprisingly higher %BF than both the local (7%) and university (7.6%) teams. Interesting to notice the higher variance of the body weight values for the national and university team compared to the elite players which show to be more homogeneous in this respect. These results can be explained based on the age and the playing and training experience of the teams, but they should be utilized anyway to drive the coaches and the players themselves for the planning and implementing of the special and specific nutritional and training programmes which better fit to the team in general and to the individuals in particular, aiming the improvement of such parameters.

From the comparison of the jump tests between the teams, the elite team displays slightly better absolute values of HA but lower value for JTH and an intermediate result for JOH. The jump tests results reveal also a higher variance of those in the elite team (higher heterogeneity in values distribution) than those of the other teams which show a more homogeneous distribution of these parameters. Worth to notice, that the local team presents better absolute and relative values, compared to the other teams for both jump tests. These data could lead and guide the coaches in the selection process of the new elements for the elite teams.

The comparison between the two sets of parameters is supported by the logic that these are collinearly interdependent; i.e. a higher BH determines a presumable higher HA and these two a higher jump height. The above argumentation is faced by the results obtained in each team.

The comparison reveals surprisingly, but in line with the previous interpretation and discussion, that the elite team which presents better physical parameter values, i.e. higher BH and HA, it displays lower jumping height (+56.9 cm JOH and +45.3 cm JTH over the HA value) against local team (+60.4 cm JOH and 52.5 cm JTH) and the university team (+ 59.3 cm JOH and 47.9 cm JTH).

The elite team, although starts advantageous due to the better physical parameters (higher BH and higher HA compared to the two other teams) display in fact lower relative jumping height (jumping distance beyond HA) both for JOH and JTH than the other teams. The local team presents also the highest absolute jumping height compared to the other two. On the other side, the university team (older in age) shows better relative jump ability compared even to the elite team. It is up to the coaches to further analyze these parameters, understand the individual and training factors and also elaborate appropriate programmes aiming the improvement of such parameters; these analyses should stand on the basis of the preselection and selection processes and procedures for the elite players of any level.

Despite the differences between the teams, the results of this study in terms of absolute values, the deviation range and the differences between the teams, show however a continuous improvement of the physical and performance parameters in our volleyball teams, compared especially to the last 5-10 years (Pogoni et al., 2003). The differences call however, the need for reflection and planning of specific, team and individual oriented training and nutritional programs, in order to improve both anthropometric and body composition values which are under training influence and at the same time directly reflect on the physical performance (Fleck et al., 1985).

The investigation and analysis of the 11 blood markers revealed mean values within the norm for most of the White Blood Cell population for all three teams, considering gender and age. WBC population shows also lower differences between the three groups.

The situation shows different for the red blood cell population: teams values show low or tendency to the lowest norm levels for 5 out of 7 parameters of RBC population and markers to them related (Rbc, Hgb, Hct, MCH, and MCHC). The Haematocrit (Hct) data show a lower level than the norm for all three teams, Hgb is at the lowest level of the norm, MCH and MCHC around the lowest norm levels for these parameters. Although no significant differences were found between the teams means, the local team displays the lowest values (under the norm) for Hct, Hgb, MCH and MCV. Worth also to mention the higher variance of the Hgb values among individuals for all three teams. These data, combined to low levels of Haematocrit, relative low RBC counts and tendency to lower levels of MCH, MCV and MCHC should call

for special attention to anemia problems within the teams and medical care as a matter to be seriously addressed by the coaches.

As a matter of fact the local team belongs to the youngest age range which could probably explain the above results in this particular group/team and which should be taken into consideration for this group and the players individually.

The above results at both team and individual level could be used firstly, to identify eventual health or performance related problems and secondly help and guide the coaches and players themselves to take the proper measures and plan the most appropriate training programs to better fit the players and the team as a whole.

This study evaluated the anthropometric, performative and haematological parameters of three Teams of female volleyball players in Albania. The present investigation provides an insight into these characteristics, makes an overall analyses and group profiling through such parameters with respect to age and comparisons between the teams in function of individual and group profiling as well as for the performance based selection process and criteria. Additional markers, further and more detailed analysis at individual levels should and will be performed, in order to identify eventual positive or abnormal alterations which could involve both health and/or sport performance for the players and in relation to their team role as well.

The above analysis, tests and studies should be periodically undertaken in order to allow coaches and trainers, to elaborate appropriate training programs in accordance and fitting to the individual physical and physiological profile and also to use them as a starting platform for the professional evaluation, selection and performance development of the elite sportpersons.

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