

Evaluation and comparative analysis of the results of a vertical jump between young basketball and handball players

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Abstract

Background and Study Aim Team sports, basketball and handball, as well as their competitions, are very popular throughout the world. The aim of this research was evaluation and comparative analysis of the results of a vertical jump between young basketball and handball players.

Material and Methods A group of 37 participants took part in the research: 21 basketball players from the basketball club OKK "Novi Pazar" (age: 15.5 ± 0.5) from Novi Pazar formed the first subgroup and 16 handball players from the handball club RK "Železničar 1949" (age: 25.4 ± 5.8 ; body height = 193.5 ± 7.5 cm; body weight = 94.0 ± 7.4 kg; body mass index = 25.03 ± 2.38 kg/m²) from Niš formed the second subgroup. Explosive power of the vertical jumps was assessed by the following tests: countermovement jump, countermovement jump/arm swing, squat jump. Participants had at least 5 years of training experience and held similar acute training histories prior to study commencement, completing 4 weeks of baseline conditioning during the general preparatory phase. Participants were free of injury, illness and disease as determined by a team physician prior to study participation.

Results The results of the independent samples t-test show that there were no significant differences ($p > 0.05$) between basketball and handball players in all vertical jump tests.

Conclusions This article contains new information about vertical jumps of young male basketball and elite male handball players that could be extremely useful for coaches. Also, these findings suggest that basketball coaches may benefit from talents' identification in young basketball players.

Keywords: team sports, explosive power, lower limbs, jumping performance, differences

Introduction

Team sports, basketball and handball, as well as their competitions, are very popular throughout the world. Success in these sports depends on several anthropological dimensions, whose relationships are different. Thanks to the very intensive development of technique and tactics in recent years, both these sports games have become very complex and demanding. Basketball and handball are characterized by similar movement structures, such as a constant change in the phase of attack and defense, rapid changes in the direction of movement, sudden stops and dribbles, as well as a large number of jumps in attack and defense. However, there are differences and specifics in the structure of each sports game, such as different rules of the game, duration of the match, number and position of

players on the field, different structure of certain types of movement in attack and defense, etc. [1].

Explosive power, often assessed as vertical jump, is a foundational component of vital movements [2, 3] in many collective sports [4, 5], such as rugby, volleyball, basketball, handball and soccer [6-10]. Basketball and handball are characterized by explosive, unilateral actions such as jumping [11] and has been considered as fundamental for successful performance [12] in these sports. Since vertical jumps are the predominant elements of the game in both sports, their successful realization depends on the explosive power of the lower limbs. Vertical jumps are used when players make certain important technical acts such as the shot in basketball [13, 14] or the shot or block in handball, which require not only a high jump but also the correct direction of forces of the upper limb in order to try blocking the opponent's shot. In fact, a greater jump height achieved during a jump in basketball

produces more favourable condition for shots and rebounds [12], while in handball the achievement of a greater jump height provides a clear advantage in the attack and block actions. The following factors can also affect the characteristics of vertical jumps in basketball and handball: the trajectory of the ball, the skill level of the players, body contact with surrounding players, or the type of action performed (offensive or defensive). These factors make each jump a relatively different task [15].

Numerous studies have shown the importance of vertical jumps in young elite male basketball players [15-19, 20, 21]. The explosive power in the form of vertical jumps is a significant characteristic of basketball players, and it is one of the most important factors in achieving top sports results [22, 23]. During the game, basketball players spend 34% of their time running and jumping, 56.8% walking, 9% of their time standing and changing their form or intensity of movement on average every 2 seconds [24]. Also, in basketball, the vertical jumps dominate because of facilitating the realization of specific technical and tactical elements [1, 25].

Several original studies [26-30, 31] showed the importance of jumping ability in elite male handball players. Also, it should be emphasized that explosive power of throwing type is particularly important for success in handball [26]. The success of vertical jumps is determined by the velocity at take-off [31]. As it is well known, handball and basketball studies have used standardized jump tests from a standing position using a 2-legged take-off (i.e., vertical countermovement jump with and without an arm swing, squat jump [29]). Therefore, vertical jumps are considered as an essential motor skill in a range of team sports, including basketball [32] and handball [33]. However, it is not known if there are differences in vertical jumps between young basketball players and senior handball players. Thus, it is expected that there are differences in vertical jumps, in favor of handball players, and the key factors that contribute to the confirmation of this hypothesis are biological maturity, the skill level of players and age players.

Therefore, the aim of this research was to evaluate and comparative analysis of the results of a vertical jump between young basketball and handball players.

Material and Methods

Participants

A group of 37 participants took part in the research. They were divided into two subgroups: 21 young elite male basketball players from the basketball club OKK "Novi Pazar" (age: 15.5 ± 0.5 ; body height = 185.15 ± 7.13 cm; body weight = 75.14 ± 11.91 kg; body mass index = 21.93 ± 2.90 kg/m²) from Novi Pazar formed the first subgroup and 16 elite male handball players from the handball club

RK "Železničar 1949" (age: 25.4 ± 5.8 ; body height = 193.5 ± 7.5 cm; body weight = 94.0 ± 7.4 kg; body mass index = 25.03 ± 2.38 kg/m²) from Niš formed the second subgroup. Participants had at least 5 years of training experience and held similar acute training histories prior to study commencement, completing 4 weeks of baseline conditioning during the general preparatory phase. Participants were free of injury, illness and disease as determined by a team physician prior to study participation. All participants were informed of the study aims and gave informed written consent to participate prior to testing. Based on the average values of body mass index we can say that our participants are among the elite population of young basketball and handball players. The study was conducted according to the Declaration of Helsinki and the protocol was fully approved by the Ethics Committee of the Faculty of Sport and Physical Education before commencement.

Research Design

Prior to physical performance testing, participants completed a standardised warm-up consisting of moderate intensity jogging (8 min), static stretching (5 min) and brief bouts of high-intensity running (2 min). To assess the anthropometric characteristics, the following were: body height (BH), body mass (BM) and body mass index (BMI) were calculated. Data on the anthropometric measures were not subjected to statistical analysis and were used to describe the sample of participants. Explosive power of the vertical jumps was assessed by the following tests: countermovement jump (CMJ), countermovement jump/arm swing (CMJAS), squat jump (SJ). All jumps were performed on a photocell mat (Optojump, Microgate, Bolzano, Italy) which measures flight time between take-off and subsequent landing to calculate jump height (cm). Validity and reliability of the Optojump system has been confirmed in previous research [34]. Each trial was validated by a visual inspection to ensure that each landing was performed without any leg flexion; furthermore, participants were instructed to maintain their hands on their hips during the CMJ and squat jump and to use the arm swing in the CMJAS. The CMJ (with and without an arm swing) was performed starting from a standing position after which participants were asked to jump as high as possible with a rapid, preparatory downward eccentric action. The depth of the CMJ was self-selected. Participants performed the squat jump starting from a standing position, bending the knees to 90°, stopping for 3 s, and then jumping as high as possible to avoid any knee or trunk countermovement. Each test was performed three times, separated by 1 min of passive recovery, and the best jump was recorded and used for analysis. Participants were wearing athletic shoes during all jumps.

Statistical analysis

Data processing used basic descriptive parameters: range (Range), minimum value (Min), maximum value (Max), arithmetic mean (Mean), Standard deviation (SD), rate asymmetry (Skewness and Kurtosis). The t-test (independent samples test) was used for comparison between the two groups of participants. The magnitude of difference between basketball and handball players was measured using effect size (ES) and interpreted using previously established criteria: *trivial* = <0.20; *small* = 0.2–0.59; *moderate* = 0.60–1.19; *large* = 1.20–1.99; *very large* = > 2.0 [35]. The statistical significance was set at the level of $p < 0.05$. All statistical analyses were performed using SPSS 19.0 software (SPSS Inc., Chicago, IL).

Results

Descriptive parameters for basketball and handball players are shown in Tables 1 and 2. By examining the tables and comparing the results of Standard Deviation (SD), with maximal range (Max) and minimal (Min), the normal sensibility of chosen tests was concluded.

With the group of young basketball players shown in Table 1, the values of Skewness show that

there are no significant deviations of the results from the normal distribution in any of the measures, considering that the values do not exceed 1.00 in any of the variables. The Kurtosis values in all variables are below 2.75, which indicates platykurtic distribution.

The analysis of the basic statistical parameters of the vertical jumps among handball players shown in Table 2 indicates that Skewness show that there are no significant deviations of the results from the normal distribution in any of the measures, considering that the values do not exceed 1.00 in any of the variables. The Kurtosis values in all variables are below 2.75, which indicates platykurtic distribution.

Table 3 indicates the vertical jumps characteristics of basketball and handball players and results of the comparison between these two groups of players (t-test). Levene’s Test of Equality of Error Variances have shown that the assumption of equality of the variance was not violated ($p < 0.05$). There were no significant differences ($p > 0.05$) between basketball and handball players in all vertical jump tests (CMJ, CMJAS, and SJ). *Trivial* ES differences between basketball and handball players were observed in CMJ (ES = 0.09), CMJAS (ES = 0.09), and SJ (ES = 0.08).

Table 1. The basic statistical parameters of the vertical jumps in basketball players

Variables	N	Range	Min	Max	Mean	SD	Skewness	Kurtosis
CMJ	21	20.10	21.30	41.40	32.06	5.40	-.335	-.299
CMJAS	21	25.50	25.00	50.50	38.54	6.98	.025	-.110
SJ	21	20.40	20.00	40.40	30.95	5.11	-.253	-.146

Note: number of participants (N), range (Range), minimum (Min), maximum (Max), arithmetic mean (Mean), standard deviation (SD), Skewness (Skewness), Kurtosis (Kurtosis), countermovement jump (CMJ), countermovement jump/arm swing (CMJAS), squat jump (SJ).

Table 2. The basic statistical parameters of the vertical jumps in handball players

Variables	N	Range	Min	Max	Mean	SD	Skewness	Kurtosis
CMJ	16	15.80	24.90	40.70	32.10	4.32	.526	-.037
CMJAS	16	17.80	28.40	46.20	38.00	4.51	-.222	.294
SJ	16	11.90	25.00	36.90	30.54	3.97	.416	-.942

Note: number of participants (N), range (Range), minimum (Min), maximum (Max), arithmetic mean (Mean), standard deviation (SD), Skewness (Skewness), Kurtosis (Kurtosis), countermovement jump (CMJ), countermovement jump/arm swing (CMJAS), squat jump (SJ).

Table 3. Means ± standard deviation of all variables for basketball and handball players and the comparison between these two groups (results of independent samples t-test).

Variables	Basketball Players	Handball Players	t	p	ES	Magnitude
CMJ	32.06 ± 5.40	32.10 ± 4.32	-0.27	.979	0.09	Trivial
CMJAS	38.54 ± 6.98	38.00 ± 4.51	.264	.794	0.09	Trivial
SJ	30.95 ± 5.11	30.54 ± 3.97	.259	.797	0.08	Trivial

Note: countermovement jump (CMJ), countermovement jump/arm swing (CMJAS), squat jump (SJ), the value of the differences between young basketball and handball players (t), statistical significance of differences ($p < 0.05$), effect size (ES), Magnitude-based inferences (Magnitude).

Discussion

The primary purposes of this study was to evaluation and comparative analysis of the results of a vertical jump between young basketball and handball players. Results of this study have shown that there were no significant differences between basketball and handball players in all vertical jump tests (CMJ, CMJAS, and SJ). *Trivial* differences were evident across all vertical jump tests. It was hypothesized that there were differences in vertical jumps between young elite male basketball and elite male handball players. Surprisingly, our hypothesis not accepted. These results were not expected, and the reason for that can be an age, genetic predisposition, the average values of BMI, and the skill level of players. The age of participants is one of the most important components. The most sensitive factor of given results is age, since the training of young basketball players mustn't be based on the principles that training for adults is based on. It has to be in compliance with their biological, chronological, psychological and physical growth.

There are several explanations for these results. The obtained results can be justified by the fact that the technical and tactical basketball trainings, as well as basketball matches, involve a large number of vertical jumps with both legs both in attack and defense. In basketball, the jump in attack and defense is performed with maximum vertical reflection, which is not the case in handball. The exception is when the basketball players perform a jump from the movement after the bounced ball or when performing a shot on the basket from the movement, then they perform with a stronger leg. It is similar with handball players, when taking a shot on goal from the move, they perform with a stronger leg. In addition to the tests used in this study, a vertical single leg countermovement jump may have been required. This would be interesting, because in that way we would have a clearer ratio of vertical jumps from one and both legs in young basketball players and handball players.

The significance of vertical jumps in basketball is also confirmed [25] with the fact that one basketball match consists of (46 ± 12) jumps per one player [36, 37], i.e. a basketball player performs up to 100 different jumps in a game [38]. During half an hour the player jumps about (16-17) times, and when we count it, we get 35 times during the whole match [39]. The importance of vertical jumps for basketball is also indicated by the fact that better placed national teams, at the 2006 World Cup in Japan, successfully catch bounced balls under the opponent's basket - jump in attack [40]. In handball, vertical jumps are also crucial [26, 31, 41, 42], but this sport is also characterized by a large number of horizontal jumps. Results of this study have shown that throwing is one of the most

important technical skills in modern handball as it is the major determinant of all actions taken by the players. The of research Bojić et al. [1] points to an importance of vertical and horizontal jumps in handball such as: shooting past the block, defence blocking, shooting while getting into the goalkeeper's line from different players' positions. Results of this study have shown that basketball players achieved statistically better results in vertical jump tests, whereas handball players did better in horizontal jump tests. Similar results were found in a study of [43] which have shown that male basketball players achieved better results in vertical jump tests (SJ and CMJ) as compared to male handball players. In contrast, Peña et al. [44] have shown that there were no significant differences in vertical jumps between basketball and handball players. Furthermore, volleyball players have shown significantly better results than basketball and handball players in CMJ and CMJAS jumps, while in SJ test there was no difference between the groups. It would be interesting to examine the differences in horizontal jumps on the same or a similar sample of participants, or to examine the differences in vertical jumps after applying an experimental program (for example plyometric or resistance training) which is a recommendation to future researchers on this or similar topic.

Comparison between our results and those made previously are difficult to conduct, considering the lack of existing researches in young elite male basketball and elite male handball players. Previous studies [1, 43, 44] had groups of the same or similar age for the sample, which was not the case in this study. Our findings were obtained in young male basketball players, and senior male handball players and it is questionable whether the present results for the examined tests hold true for female samples. Therefore, the comparison of our study with the above should be viewed in the context of relevant limitations. Therefore, this article contains new information about vertical jumps of young elite male basketball players and elite male handball players that could be extremely useful for coaches. Also, these findings suggest that basketball coaches may benefit from talents' identification in young basketball players. In addition, our results could be incorporated into a database according to which talented young basketball players could be compared.

Despite interesting outcomes in this study, some important limitations should be acknowledged. Firstly, basketball players were tested in the evening (20:00-21:30 h) and handball players in the morning (8:00-9:30 h). It is well known that there are morning-to-evening differences in physical performance with and without ball in elite male handball players [29]. Future studies should identify if training administered in the morning

can reduce morning-to-evening differences in basketball players. Secondly, limitation of the study was relatively small sample size (n=37). However, to make the differences in vertical jumps clearer, an effect size (ES) was calculated for each variable. Thirdly, although our findings provide valuable insight into young elite male basketball and elite male handball players, the applicability of these results remains limited to other ages, playing levels and females. Fourthly, handball is very complex sports activity, where successful performance particularly depends on explosive strength (of throwing type) and basic strength of the trunk [26, 45], while in basketball the most important is the explosive power of vertical jumping.

Conclusions

The present study, despite its limitations, revealed that there were no differences in vertical high jump tests between young elite male basketball

players and elite male handball players. This article contains new information about vertical jumps of young male basketball and elite male handball players that could be extremely useful for coaches. Also, these findings suggest that basketball coaches may benefit from talents' identification in young basketball players. Thus, more research is needed to examine vertical jumps among young basketball players and handball players.

Highlights

No differences in vertical high jump tests (CMJ, CMJAS, SJ) between young elite male basketball players and elite male handball players.

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Conflicts of interest

All authors have no conflicts of interest.

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