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PREDICTING MAXIMAL COUNTERMOVEMENT JUMP HEIGHT FROM UPRIGHT AND SQUAT POSITIONS

HEAD TITLE: UPRIGHT AND SQUAT MAXIMUM JUMP HEIGHT PREDICTORS

David N. Suprak[1] and Tal Amasay[2]

[1]Department of Health and Human Development, Western Washington University, Bellingham, WA, USA
[2]Department of Sport and Exercise Sciences, Barry University, Miami, FL, USA

ABSTRACT

Introduction. Countermovement jump is common in sport and testing and performed from various starting positions. Little is known about effective contributors to maximal countermovement jump height from various starting positions.

Purpose and Objectives. Determine effective jump height predictors and effect of starting position on countermovement jump height.

Applied Methodology. Forty-nine collegiate athletes performed maximal height countermovement jumps from upright and squatting positions with arm movement. Several variables were calculated from kinetic data. Correlation and regression determined variables related to and predictive of jump height in both conditions. Paired t-tests evaluated differences in jump height.

Achieved Major Results. Upright condition jump height positively correlated with peak force and power, eccentric and concentric impulses, and countermovement depth. Jump height prediction included peak force and power, and eccentric and concentric impulses. Squat condition jump height positively correlated with peak force and power, mean rate of force development, force generated at the beginning of propulsion, and concentric impulse. Jump height prediction equation included mean rate of force development, force at the beginning of propulsion, and peak power. Jump height was higher in the upright condition.

Conclusions. Higher jumps are achieved from the upright position. Peak force, peak power, and concentric and eccentric impulses best contribute to upright jump height. Mean rate of force development, force at the beginning of propulsion, and peak power best predicted squat jump height.

Limitations. We did not restrict arm movement, to encourage natural motion. Depth was not controlled, rather advising a comfortable depth. Subjects were recruited from various collegiate sports.

Practical implications. Maximal jump height from various positions may be achieved through efforts to maximize jump peak power and increase musculotendinous loading in sport-specific starting positions.

Originality/Value. This is the first study to explore the predictors of upright and squat countermovement jumps. These results can guide jump performance training.

***Keywords**: Impulse, Countermovement, Peak Force, Peak Power, Starting Position*

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ORCID
David N. Suprak
https://orcid.org/0000-0002-7259-3648
Tal Amasay
https://orcid.org/0000-0002-7614-3150

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INTRODUCTION

A countermovement jump (CMJ) is an explosive jump comprised of a preliminary downward motion followed by an upward motion, accelerating the center of mass vertically. This maneuver is common both in activities of daily

living, as well as in many sporting environments, and takes advantage of the stretch-shortening cycle (SSC). The SSC combines the eccentric (lengthening) and concentric (shortening) actions of an agonist muscle to capitalize on the force generation from both the stretch reflex and stored elastic energy in the tendon to maximize force output at the beginning of the concentric phase, as well as increased crossbridge formation during the eccentric phase (Cormie et al., 2010), resulting in production of net vertical impulse at a higher rate and shorter amount of time (Guess et al., 2020). The potential of the SSC to result in maximum force output during the concentric phase depends on range of muscle lengthening, as well as shortening velocity and acceleration (Cormie et al., 2010, Mandic et al., 2015). In addition, a countermovement may allow for development of a higher level of muscle active state, resulting in greater joint moments at the start of the concentric phase (Bobbert et al., 1996).

The CMJ is used extensively as a simple test that lends insight into the neuromuscular and SSC capabilities of the lower extremity. As such, much work has been done to examine variables related to CMJ execution and their contribution to jump performance and efficiency. CMJ performance is often assessed using 3D camera systems and force platforms, specifically examining the vertical ground reaction forces (vGRF) to derive the force-time curve, and numerous related variables. Such research has demonstrated the countermovement depth (Perez-Castilla et al., 2019, Sanchez-Sixto et al., 2018), rate of force development in the eccentric phase (ERFD) (Barker et al., 2018, Laffaye & Wagner, 2013), eccentric phase impulse (Sole et al., 2018), peak force (Daugherty et al., 2021, Dowling & Vamos, 1993), peak rate of force development (RFD) (McLellan et al., 2011), and peak power (Barker et al., 2018, Daugherty et al., 2021, Dowling & Vamos, 1993, Harman et al., 1991) during the jump are all positively related to maximal jump height.

In sports, athletes often begin explosive movements, such as countermovement jumps, from various positions, depending on the situation. Previously, Amasay (2008) reported greater maximal jump height when starting from the upright, compared to a self-selected squat, position in a maximal height block jump in collegiate volleyball players. However, little is known regarding the relative importance of factors contributing to success in CMJs performed for

maximal jump height (JH) from upright and squat starting positions. Therefore, the purpose of this study was to use a bivariate correlation and multiple regression approach to determine effective predictors of JH in CMJs performed for maximal height from both upright and squat positions. A secondary purpose was to determine the effects of starting position (upright vs. squat) on JH in a CMJ performed for maximal height. The knowledge gained could be helpful in designing targeted training programs for improving JH and lower extremity explosive performance. In accordance with previous research, we hypothesized that variables related to force generation (peak force, rates of force development, and impulse), peak power, and countermovement depth would exhibit greater correlations with, and be more predictive of, JH than other variables. We also hypothesized that variables related to the eccentric phase of

CMJ would be more predictive of JH in the upright, compared to the squat, starting position. Further, we hypothesized greater JH from the upright versus the squat starting position.

METHODOLOGY

Ethical Statement

The university institutional review board approved the study in accordance with the Helsinki Declaration. All subjects read and signed an informed consent form prior to data collection.

Subjects

Forty-nine Division II athletes (22 males, 27 females) participated in the study. Subject demographics are presented in table 1. The athletes participating in the study were from different collegiate varsity teams including soccer, basketball, tennis, rowing, softball and baseball. All subjects were free of acute injuries prior to the testing and cleared by the university sports medicine staff to participate in their team training and this study without limitations.

Table 1. *Subject demographics.*

	Age (yrs)	Height (cm)	Weight (kg)	College Experience (yrs)	Total Experience (yrs)
Group Mean (SD)	20.2 (1.5)	175.3 (8.6)	73.8 (10.6)	2.8 (1.2)	11.0 (4.6)
Women Mean (SD)	20.4 (1.4)	171.5 (8.2)	67.8 (7.4)	2.9 (1.2)	8.7 (4.6)
Men Mean (SD)	20.0 (1.5)	179.9 (6.6)	81.2 (9.1)	2.7 (1.2)	13.7 (2.7)

Procedure

All data were collected in a single session. Subjects performed a 10-minute general and specific dynamic warm-up before testing began. The general warm-up consisted of riding a stationary bike at a self-selected pace. The specific warm-up consisted of high knees, heel to toes, marching, squats, front lunges, carioca, and submaximal vertical jumps.

Kinetic data were collected using two adjacent in-ground AMTI OR6-6 force plates (Advanced Mechanical Technology, Inc., Watertown, MA, USA) sampled at 960 Hz, and Vicon Nexus 1.7.1 software (Vicon, Centennial, CO, USA). Data were filtered via a fourth order Butterworth low-pass filter with a cutoff frequency of 300 Hz.

Subjects' body weight was calculated using the summed vGRF from the force plates during a standing trial. Each subject stood on the force plates for at least 3 seconds. The vGRF from each force plate recorded over middle second was averaged while the subject stood motionless and the data from the two force plates were summed to calculate subjects' body weight in newtons.

Following the warm-up, subjects performed three maximal height CMJs from the upright starting position and three maximal height CMJs from a squat starting position, separated by at least two minutes of rest. Subjects were positioned with one foot on each force plate, and a Vertec (Sports Imports, Columbus, OH, USA) positioned as a target so subjects could jump vertically and touch its vanes. For the upright maximal CMJs, subjects began by standing in a comfortable upright position. Subjects were instructed to perform

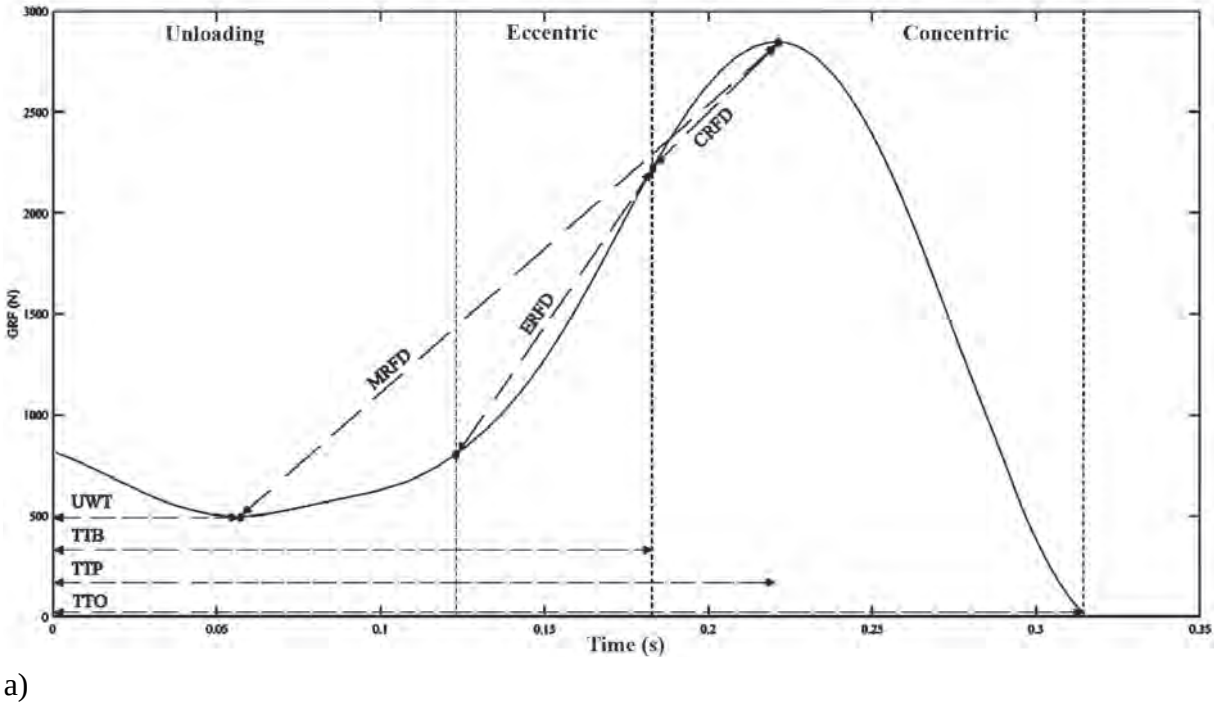
a rapid countermovement to a self-selected depth and immediately jump vertically with maximal effort. Subjects were required to land with both feet on the force plates on which they began, or jumps were repeated. The maximal CMJ from the squat position was performed identically to the upright jump but beginning from a self-selected squatting position. Subjects were instructed to assume a self-selected squat position, similar to the starting position they would adopt when playing their sport. As with the upright condition, subjects were instructed to perform a rapid countermovement to a self-selected depth and immediately jump vertically with maximal effort. Arm movement was not restricted during jumps. The jump with the highest center of mass (COM) vertical displacement of the three jumps, from each starting position, calculated from the kinetic data was taken as their maximal vertical jump. Kinetic data were used for all subsequent calculations.

Data were analyzed via custom written Matlab R2020 software (Mathworks, Natick, MA). The start of the countermovement was identified when the vGRF was above or below the body weight by more than 2.5% of body weight (Barker et al., 2018), and stayed for at least 50 data points. Toe-off was identified when the vGRF dropped below 20 N (Barker et al., 2018), and stayed for at least 100 data points. Vertical COM velocity at take-off was calculated as the integration of COM acceleration (a = (vGRF – body weight)/mass). JH was then calculated from COM velocity with the equation in Table 2. The trial with the highest JH was analyzed for each subject for each starting position. Fifteen variables were calculated for each jump, based on the kinetic data collected: JH (m), eccentric rate of force development (ERFD) (N/s), concentric rate of force development (CRFD) (N/s), mean rate of force development (MRFD) (N/s), peak RFD (PRFD) (N/s), force at the bottom of the countermovement (FAB) (N), peak force (PF) (N), unweighting time (UWT) (s), time to bottom of the countermovement (TTB) (s), time to peak force (TTP) (s), time to take-off (TTO) (s), eccentric Impulse (EccImp) (Ns), concentric impulse (ConImp) (Ns), peak power (PP) (W/kg), and COM displacement during the countermovement (CMDepth) (m). The formulas for each of these variables are shown in Table 2. An illustration of the phases of the CMJ, RFDs and times calculated in this study is presented in Figure 1.

Table 2. *Variable calculation formulas.*

Variable	Formula
Jump height (JH) (m)	$JH = \frac{COM\ takeoff\ velocity^2}{2*9.81 m/s^2}$ vvvvvv COM velocity calculated as integration of acceleration of the COM
Peak force (PF) (N)	Maximal vertical GRF during jump
Countermovement depth (CM-Depth) (m)	Difference in COM height between starting position and bottom of the countermovement. Calculated as double integration of acceleration of the COM. Divides the eccentric (countermovement) and concentric (propulsive) phases.

Force at bottom of the countermovement (FAB) (N)	Vertical GRF at point where COM reaches the maximum negative displacement.
Eccentric rate of force development (ERFD) (N/s)	$ERFD = \frac{FAB\text{-}Force\ at\ beginning\ of\ eccentric\ phase}{change\ in\ time}$
Concentric rate of force development (CRFD) (N/s)	$CRFD = \frac{Peak\ force\ -\ Force\ at\ bottom\ of\ countermovement}{change\ in\ time}$
Mean rate of force development (MRFD) (N/s)	$MRFD = \frac{Peak\ force\text{-}minimum\ force}{change\ in\ time}$
Peak rate of force development (PRFD) (N/s)	Maximum positive slope of vertical GRF over 10-ms intervals
Unweight time (UWT) (s)	Elapsed time from beginning of the jump to the minimum vertical GRF
Time to bottom of countermovement (TTB) (s)	Elapsed time from beginning of the jump to the maximal negative COM displacement
Time to peak force (TTP) (s)	Elapsed time from beginning of the jump to the maximal vertical GRF
Time to take-off (TTO) (s)	Elapsed time from beginning of the jump to the instant of toe-off, when the subject left the ground
Eccentric impulse (EccImp) (Ns)	The area under the GRF-time curve during the eccentric (countermovement) phase
Concentric impulse (ConImp) (Ns)	The area under the GRF-time curve during the concentric (propulsive) phase
Peak Power Output (PP) (W/kg)	Maximal product of vertical GRF and COM velocity during the jump, normalized to body mass



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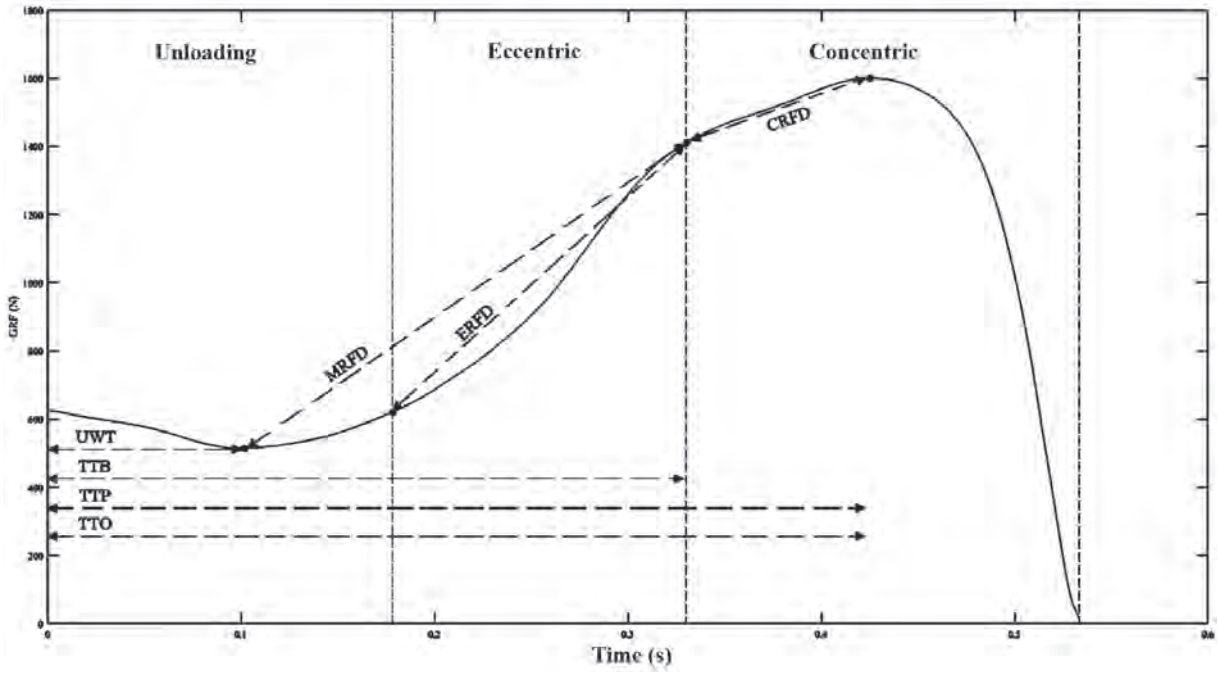

b)

Figure 1. *Illustration of jump phases and RFD calculations for a. upright and b. squat CMJ conditions*

Statistical Analysis

IBM SPSS Statistics Version 28 was used for statistical analyses. A priori power analysis was conducted using pilot data. Based on this pilot data and using the resulting adjusted multiple correlation of r = .918, fourteen predictor variables (ERFD, CRFD, MRFD, PRFD, FAB, PF, UWT, TTB, TTP, TTO, EccImp, ConImp, PP, and CMDepth), and an alpha level of $p < .05$, at least 20 subjects would be required to obtain a power level of 0.8. In addition, the power analysis for the t-test based upon a comparison of JH in CMJ and squat jump revealed that with an estimated effect size of d = 0.488 (Wadhi et al., 2018), at least 35 subjects would be required to achieve a power level of 0.8 at an alpha level of $p < .05$.

Histograms were examined to assess the assumption of normality for each variable. The Shapiro-Wilk test was used to assess normality of JH for each condition. Linearity between predictor variables and JH were assessed using bivariate scatterplots. Pearson correlation coefficients were calculated between each calculated variable and JH, and their strength was evaluated using benchmarks outlined by Field (2018). Correlation coefficients less than 0.2 were classified as weak, those between 0.2 – 0.49 were moderate, and those 0.5 and above were strong.

Only significant correlations were used to identify predictor variables to include in the regression analysis. Multicollinearity was evaluated via the variance inflation factor (VIF) for each predictor variable. In the case that two or more predictors exhibited a VIF greater than 10 (Field, 2018), the predictor with the highest bivariate correlation with the JH was kept in the model, while the

other predictor was discarded. Once appropriate predictors were identified, they were entered into a backward stepwise multiple regression, with a t-test exit criterion of $p > .1$ (Laffaye & Wagner, 2013). The analysis of variance (ANOVA) and adjusted R^2 were used to evaluate goodness of fit for the resulting regression models for upright and squat conditions.

Paired t-tests were conducted to compare JH across upright and squat conditions. The alpha level was set at $p < .05$. Cohen's *d* was used to evaluate effect sizes for these comparisons, according to the benchmarks of small (0.2), medium (0.5), and large (0.8) effects (Cohen, 1988).

RESULTS

Upright Max Jump Regression Results

Table 3 shows mean (± SD) values for each variable calculated in the upright and squat conditions. The Shapiro-Wilk test indicated that data for JH in the upright condition were normally distributed ($p = .15$). All predictor variables were normally distributed and linearly related to JH, based on examination of histograms and bivariate scatterplots, respectively. Several variables exhibited significant correlations with JH (Table 4). PF, EccImp, ConImp, and PP were all strongly correlated with JH. FAB and CMDepth showed moderate correlations with JH. No weak correlations were found to be significant.

Table 3. *Variable mean (± SD) by condition.*

	Upright	Squat
Jump Height (m)	0.391 (0.116)	0.383 (0.118)
ERFD (N/s)	6060.43 (8152.29)	5623.78 (3600.93)
CRFD (N/s)	1518.54 (2182.51)	3023.40 (2629.76)
MRFD (N/s)	3948.69 (3113.68)	3691.16 (1910.11)
PRFD (N/s)	12,509.66 (14,162.24)	11,193.12 (6528.94)
FAB (N)	1566.91 (326.06)	1230.22 (380.11)
PF (N)	1842.71 (325.34)	1794.25 (369.27)
UWT (s)	0.422 (0.348)	0.493 (0.355)
TTB (s)	0.753 (0.350)	0.689 (0.364)
TTP (s)	0.903 (0.359)	0.902 (0.387)
TTO (s)	1.05 (0.362)	1.01 (0.385)
RSIMod (m/s)	0.397 (0.148)	0.436 (0.238)
EccImp (Ns)	77.18 (24.88)	26.79 (22.44)
ConImp (Ns)	211.98 (53.72)	205.69 (51.78)
PP (W/kg)	56.56 (12.93)	55.93 (13.06)
CMDepth (m)	0.279 (0.085)	0.014 (0.098)

Variables with significant correlations with JH were entered into the backward stepwise multiple regression analysis. After excluding variables with non-significant t-values, or

with VIF greater than 10, the variables that remained in the regression model were PF, EccImp, ConImp, and PP (F[4, 44] = 481.42, p < .001, adjusted R^2 = .976). These variables significantly predicted JH with the equation:

Jump Height = -.056 – 0.00013(PF) + 0.001(EccImp) + .001(ConImp) + 0.008(PP).

Table 4. *Pearson's correlation coefficient for each variable with JH in the upright starting position.*

	ERFD	CRFD	MRFD	PRFD	FAB	PF	UWT	TTB	TTP	TTO	EccImp	ConImp	PP	CMDepth
JH	-.036	.078	.028	.040	.440*	.641*	.257	.266	.273	.256	.555*	.797*	.960*	.487*

**Denotes significance (p < .05).*

Squat Max Jump Regression Results

The Shapiro-Wilk test indicated that data for JH in the squat condition were normally distributed (p = .197). Histograms and bivariate scatterplots demonstrated that all predictor variables were normally distributed and linearly related to JH. As with the upright max results, several variables in the squat max jump were significantly correlated with JH (Table 5). PF, ConImp, and PP were all strongly correlated with JH. Variables with moderate significant correlations to JH included MRFD and FAB. No weak correlations were significant. The variables with significant correlations with JH were entered into the backward stepwise multiple regression analysis. After excluding variables with non-significant t-values, or with VIF greater than 10, the variables that remained in the regression model were MRFD, FAB, and PP. This model significantly predicted JH (F[3, 45] = 332.50, p < .001, adjusted R^2 = .954). The resulting prediction equation was JH = - 0.197 - .00001(MRFD) + .000021(FAB) + .009(PP).

Table 5. *Pearson's correlation coefficient for each variable with JH in the squat starting position.*

	ERFD	CRFD	MRFD	PRFD	FAB	PF	UWT	TTB	TTP	TTO	EccImp	ConImp	PP	CMDepth
JH	.269	.224	.305*	.226	.329*	.657*	.158	.097	.101	.092	.259	.843*	.969*	.037

**Denotes significance (p < .05).*

Upright vs. Squat Condition Comparison

Paired t-tests indicated JH was significantly higher in the upright, compared to the squat, max jump condition (t(48) = 2.54, p = .014). However, the mean difference between conditions was small (0.0086 m), with a small effect size (d = .363).

DISCUSSION

The primary purpose of this study was to use a bivariate correlation and multiple regression approach to determine the most effective predictors of JH in a CMJ performed for maximal height from both upright and squat starting positions. We hypothesized that variables related to force generation, counter-

movement depth, and PP would exhibit greater correlations, and be more predictive of, JH than others. Our hypothesis was partially supported, since the variables exhibiting significant correlations with JH in the upright condition included PF, PP, EccImp, FAB, ConImp, and CMDepth. This result was expected, since previous authors have reported significant positive correlations between JH and PF (Daugherty et al., 2021, Dowling & Vamos, 1993), PP (Barker et al., 2018, Daugherty et al., 2021, Dowling & Vamos, 1993, Harman et al., 1991), CMDepth (Perez-Castilla et al., 2019, Pérez-Castilla et al., 2020, Salles et al., 2011, Sanchez-Sixto et al., 2018), and EccImp (Sole et al., 2018).

One unexpected result was that ERFD did not show a significant correlation to JH, which contrasts with previous findings (Barker et al., 2018, Laffaye & Wagner, 2013). However, this discrepancy may be due to a difference in the definition of the eccentric phase between these reports and the current study. In both of these previous works, the authors defined the beginning of the eccentric phase as the point of minimum GRF (maximum unweighting), whereas in the current study, we defined it as the point of maximum downward velocity of the COM (corresponding to the point when GRF returns to body weight), in accordance with other more recent works (Sahrom et al., 2020, Sole et al., 2018). This difference in the definition of the start of the eccentric phase may contribute to a difference in the calculation of ERFD, and therefore, the difference in findings here.

The variables that best predicted JH from the upright position in the resulting regression model included PF, PP, EccImp, and ConImp. According to the present results, FAB was strongly significantly correlated with PF (r = .769, p > .001), ERFD (r = .549, p < .001), EccImp (r = .503, p < .001), and ConImp (r = .681, p < .001). In addition, FAB was moderately correlated with PP (r = .442, p = .001). Therefore, it may be that, although we did not find a correlation between ERFD and JH, greater ERFD and EccImp are related to higher FAB, which may contribute to greater ConImp and PF, and thereby, higher JH. In other words, rapid force development in the eccentric phase (ERFD) may result in large accumulation of force during this phase (EccImp), and therefore, a higher force at the end of this phase and beginning of the concentric phase (FAB). In addition, higher force developed at the beginning of propulsion (FAB) may lead to higher PP, and therefore, a higher JH. Indeed, rapid eccentric muscle action immediately prior to concentric action results in residual force enhancement from intramuscular proteins and tendon stretch, and thereby, greater force at the beginning of propulsion as well as elevated force and power in the concentric phase of a stretch-shortening cycle (Fukutani et al., 2017), such as a CMJ. Efforts to improve lower extremity explosive performance and JH from the upright position may, thus, benefit from a focus on maximizing the rate of and total force generation during the eccentric phase of the SSC, as well as maximum force generation capacity.

In a maximum height jump from the squat starting position, the current data indicated strong positive correlations of PF, ConImp, and PP with JH. Moderate positive correla-

tions with JH were found for MRFD and FAB. Therefore, increasing FAB, MRFD, ConImp, PF, and PP are associated with higher JH from a squat starting position. It is not surprising that neither EccImp nor CMDepth were significantly associated with JH from the squat position, as they were in the upright position, since CMDepth, and thus the eccentric phase, was much smaller in the squat condition (0.279 m in upright vs. 0.014 m in squat). This finding agrees with our hypothesis.

The significant regression model predicting JH in the squat starting position included only the variables MRFD, FAB, and PP. So, our hypothesis was only partially supported regarding the squat condition, since the regression equation retained some of the force-related variables, but not others. This model suggests that JH is maximized in a situation in which rapid generation of force after unweighting (MRFD) and high force generation at the beginning of propulsion results in high maximum power output, and ultimately higher JH. Further examination of these variables reveals that MRFD was strongly correlated to PRFD (r = .861, p < .001) and PF (r = .651, p < .001). This illustrates the importance of rapid force production to generate high maximum force, especially when the eccentric phase is short. FAB was strongly related to ERFD (r = .792, p < .001) and EccImp (r = .876, p < .001). So, although ERFD and EccImp were not significantly related to JH when the eccentric phase was short, this finding still shows the importance of rapid force development to generate high average eccentric force and begin propulsion at a high force. According to the current results, PP was strongly related to ConImp (r = .813, p < .001). Therefore, generating a high average force during the concentric phase of a CMJ from the squat position appears to contribute to high PP, and thereby, JH. These results may indicate that improvements in JH from the squat starting position may be achieved through efforts to increase capacity for rapid force development and generating high force at the beginning of the concentric propulsive phase, as well as improving the force generation during the concentric phase to maximize PP.

In the upright condition, both FAB (r = .44) and CMDepth (r = .487) were significantly and moderately correlated with JH. Examination of their coefficients of determination reveals that variation in FAB and CMDepth account for 19% and 24% of the variation in JH, respectively. In the squat condition, MRFD (r = .305) and FAB (r = .329) were significantly and moderately correlated with JH. Examination of their coefficients of determination reveals that variation in MRFD and FAB can explain 9% and 11% of the variation in JH, respectively. Therefore, by themselves, each of these variables doesn't predict a large portion of the variability in JH, but when entered into the regression analysis for the condition, they contribute significantly to the prediction equation of JH, as indicated by the t-value associated with each variable in the regression analysis. Therefore, we believe that these variables should be considered in the prediction of JH in their respective conditions.

Our secondary purpose was to determine the effects of starting position (upright vs.

squat) on JH in a CMJ performed for maximal height. We hypothesized greater JH from the upright versus the squat starting position. Our hypothesis was supported in that JH was shown to be higher in the upright, compared to the squat, max jump condition. Given that the CMDepth was larger in the upright versus the squat condition, this result is supported by findings from other authors. Previous authors have reported that greater countermovement depth resulted in greater net vertical impulse, greater downward and upward COM velocity, increased peak hip, knee, and ankle joint torques, and higher jump height (Salles et al., 2011, Sanchez-Sixto et al., 2018). So, although a squat starting position provides the advantage of a shorter TTO (Mandic et al., 2016), it results in a lower maximum JH. However, the difference in JH between conditions was small (0.0086 m) and may be practically inconsequential.

LIMITATIONS

This investigation had several limitations. First, we did not restrict arm movement during data jumping trials. Although restricting arm movement can isolate the contribution of the lower extremity to the jump, we felt that doing so may alter kinematics of the lower extremity, and that the results would be more applicable to sport performance if arm movement was unrestricted.

We did not control neither the depth of the countermovement in the upright condition, nor the starting position in the squat condition. Subjects were instructed to use the same countermovement or starting squat position they normally would adopt in their sport. We felt that this instruction, without dictating the movement, would result in a more natural and sport-specific movement pattern, and the best result. Future studies should assess the position at bottom of the countermovement.

Our sample of collegiate varsity athletes were taken from several different sports, including soccer, basketball, tennis, rowing, softball and baseball. These sports involve varying demands for jumping and explosive lower extremity movements. Our subjects may have had heterogenous skill levels in the movements performed, and this may have affected the results obtained.

CONCLUSION

The force-time derived variables related to, and predictive of JH are different between CMJ performed from the upright and squat starting positions. In the upright condition, the current data indicated that increasing countermovement depth, eccentric phase impulse, and force generated at the beginning of propulsion, as well as increasing concentric phase impulse, peak force and peak power, were all associated with higher JH. The JH prediction in the upright condition involved variables PF, PP, EccImp, and ConImp. Because FAB was related to PF, ERFD, EccImp, ConImp, efforts aimed at maximizing the rate of and total force generation during the eccentric phase of the SSC, as well as maximum force generation capacity, may help to optimize the impulse generated in the concentric phase and maximize the JH.

In the squat condition, increasing FAB, MRFD, ConImp, PF, and PP are associated with higher JH. The variables that best pre-

dicted JH were MRFD, FAB, and PP. These results highlight the importance of methods to increase capacity for developing rapid force and generating high force at the beginning of the concentric propulsive phase, as well as improving the force generation during the concentric phase to maximize PP to maximize JH from a squat starting position. The only variable that helped predict JH in both upright and squat starting positions was PP. Thus, in training to improve performance for sports or activities involving maximum height jumping from a variety of starting positions, it may be beneficial to focus on strategies to maximize PP during the jump, including explosive resistance training (Zemkova et al., 2014), Olympic weightlifting movements (MacKenzie et al., 2014), and plyometrics (Ozbar et al., 2014).

Maximum JH was lower in the squat condition. Coaches and trainers may employ strategies to increase lower extremity musculotendinous loading (and thereby, FAB) in athletes in their starting positions to maximize JH.

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Corresponding author:

David N. Suprak
Health and Human Development
Western Washington University Ringgold standard institution
516 High St., Bellingham, Washington 98225-9008
United States
E-mail: David.Suprak@wwu.edu

VERTICAL JUMPING PERFORMANCE RELATES TO SPRINTING PERFORMANCE OVER SHORT DISTANCES AND DIFFERENT SECTIONS

Sebastian Möck[1], René Hartmann[2], Klaus Wirth[3]

[1]Department of Exercise Science, Olympic Training and Testing Center of Hessen, Frankfurt am Main, Germany
[2]Institute of Sports Sciences, Johann Wolfgang Goethe-University, Frankfurt am Main, Germany
[3]Sport and Exercise Sciences, University of Applied Sciences Wiener Neustadt, Austria

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ORCID
Sebastian Möck
https://orcid.org/0000-0001-6277-2696

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ABSTRACT

A high level of sprinting performance is relevant in various sports. Because of the transition of movement patterns in different sprint sections there is a shift in the relevance of speed-strength of the knee and hip extensors, and stretch-shortening cycle performance seems conceivable. Fifty-six physical education students (23.70 ± 3.00 years, 176.9 ± 8.10cm, 74.20 ± 10.30kg) were investigated. They performed sprints up to 30m in which different sections were analyzed and vertical jumps (squat jump, countermovement jump, drop jump from different dropping heights). Vertical jumping tests in squat jump and countermovement jump revealed mean values of 31.95 ± 6.56cm and 34.28 ± 7.47cm, respectively, while the drop jumps showed mean RSI values between 155.11 ± 36.77 and 168.24 ± 36.29 dependent on the dropping height. The sprint test showed a mean performance of 4.464 ± .343s (30m). The correlational analysis showed significant correlations ($p < .01$) for vertical jumping height with all sprinting sections ($r = -.652$ to $-.834$). Drop jump performance also showed significant correlations ($p < .01$) with all the sections ($r = -.379$ to $-.594$).

The results let us hypothesize that the observed sample generated similar ground-reaction forces in the sprint and drop jump from a height of 40 cm.

Keywords: *Stretch-Shortening Cycle, Movement Speed, Speed-Strength*

INTRODUCTION

A high level of performance in the sprint is not only important for sprinters in track and field but also for athletes in jumping and throwing events as well as in team sports (Brechue, Mayhew, Piper, 2010; Chelly et al., 2010; Comfort, Bullock, Pearson, 2012; Di Salvo et al., 2010).

In team sports, sprints over distances of 5-20m (Abdelkrim et al., 2010, Brechue et al., 2010; Chelly et al., 2010; Comfort et al., 2012; Di Salvo et al., 2010) or durations of 1.8 – 2.1s (Abdelkrim, El Fazaa, El Ati, 2007; Spencer et al., 2004) are common and may be characterized as short events. Therefore, Cronin & Hansen (2005) emphasized the importance of the ability to produce a fast acceleration for these athletes.

In track and field, the sprint is commonly divided into phases of positive acceleration, maximum velocity, and negative acceleration (Mann, Herman, 1985; Seagrave, 1996; Volkov, Lapin, 1979). The technical recommendations for sprinting assume that in the initial acceleration phase, because of the stronger forward lean, the drive is predominantly produced by the knee extensor muscles and subsequently,

after gradually raising the upper body, shifts towards hamstring musculature (Vonstein, 1996). Substantial forward lean can also be observed in sprints from a standing starting position (Frost & Cronin, 2011). Scientific studies support this claim (Simonsen, Thomsen, Klausen, 1985, Wiemann, Tidow, 1995). Therefore, the knee extensor musculature's task during the maximal velocity phase is primarily to counteract a lowering of the body's center of mass (Simonsen et al., 1985, Wiemann, Tidow, 1995). Thus, the stiffness of the knee joint seems to be a better indicator than the maximal dynamic force of the extensors for this phase (Bret, Rahmani, Dufour, Messonnier, Lacour, 2002; Chelly, Denis, 2001). Furthermore, the ability to produce as much horizontal force as possible during the ground contact seems to be of more importance than the absolute amount of force produced (Morin, Edouard, Samozino, 2011; Morin et al., 2012). Because of these circumstances and the reduction of ground contact times throughout the sprint (Mero, Komi, Gregor, 1992), which cause shorter periods of time to transfer force to the ground, the relevance of an athlete's maximum strength seems to decrease with increasing distance while the rate of force development gains importance (Zatsiorsky, 2003, Zatsiorsky, Kraemer, 2006).

Vertical jumps like the squat jump (SJ) and the countermovement jump (CMJ) are regarded as standard tests for the speed-strength performance of the lower extremities (Bret et al., 2002, Hartmann et al., 2012, Kukolj, Ropret, Ugarkovic, Jaric, 1999, Loturco et al., 2015, Wirth et al., 2016). Previous research observed significant relationships between vertical jumping performance and sprinting speed, although contradictory findings exist. The study of Loturco et al. (2015), for example, showed significant correlations for SJ and CMJ with sprinting performance after 10, 30, and 50m for competitive sprinters $0.756 \leq r \geq 0.857$), whereas Kukolj et al. (1999) did not observe significant correlations for sports students after 15m at all and only moderate correlations of $r = .48$ after 30m.

The impact of the gradual change in posture due to the transition from the acceleration phase to the maximal velocity phase on the relevance of the strength-speed performance of knee and hip extensors for sprinting performance remains unclear.

Because of the short ground contact times of 0.08-0.11ms with little change in knee angle (Mero et al., 1992), a great performance capacity in the fast stretch-shortening cycle (SSC) with a duration < 200ms (Horita, Komi, Nicol, Kyröläinen, 1996, Horita, Komi, Nicol, Kyröläinen, 2002) is regarded as a necessity for maximizing sprinting velocity (Mero et al., 1992). Nevertheless, empirical findings utilizing the vertical drop jump (DJ) are rather scarce and show contradictory results (Cronin, Hansen 2005, Cunha et al., 2007, Hennessy, Kilty, 2001). It is noteworthy that these studies only used a single dropping height to determine SSC performance. This procedure neglects the fact that the reactive strength is linked to the dropping height, and an individual optimum exists because of the differences in the stretch velocity that elicits the reflex mechanisms upon ground contact (Komi, 2003, Schmidtbleicher, 1992).

Here as well, the relevance of DJ performance throughout the different sprinting pha-

ses remains unclear to date.

Therefore, we hypothesize that running distance increases the relationship between sprint and jumping performance.

MATERIAL & METHODS

This study aims to investigate the relationships between different vertical jumps and sprinting performance over short distances and different sections. For this purpose, 56 physical education students participated in this investigation. Concentric jump performance was measured by SJ, slow-reactive by CMJ. As a test of the fast-reactive movement behavior with different intensities, the DJ with impulse duration of less than 200ms was used. The sprint performance was measured over 30m, in which times were taken by double-photoelectric barriers after 5, 10, 15, 20, 25, and 30m, respectively. The measurements were performed on three different days with a week in-between each test and included a familiarization session and a testing session for both tests.

The following parameters were determined: Jumping height in the SJ and CMJ and reactive strength index (RSI) in the DJ from different heights as well as the spiriting times 0–5m, 0–10m, 0–15m, 0–20m, 0–25m, 0–30m and 5–10m, 10–15m, 15–20m, 20–25m, 25–30m.

Subjects

Fifty-six physical education students (40m, 16f) with a mixed sports background and activity levels participated in this investigation. The sporting backgrounds were various sport games (N = 25), metric sports (track and field, swimming; N = 15), compositional sports such as gymnastics or dancing (N = 6) and combat sports (N = 10). The mean age was 23.7 ± 3.0 years, mean height 176.9 ± 8.1cm and weight 74.2 ± 10.3kg. Each subject was informed of the experimental risks involved with the research. All subjects provided informed written consent. The research design was approved by the institutional review board. The study was carried out with respect to the use of human subjects and according to the Declaration of Helsinki.

Sprint test

The sprint test was performed after an individual warm-up of 10 minutes over a distance of 30m. This distance was chosen because it displays a relevant motor task in many sports such as soccer, football, rugby or field hockey (Brechue et al., 2010, Chelly et al., 2010, Comfort et al., 2012). Five attempts were measured with a rest period of 5 minutes between attempts. For time tracking a double-photoelectric barrier system by Refitronic (Schmitten, Germany) was used, whose measurement error is < 0,1% according to the manufacturer. The running times were detected after 5, 10, 15, 20, 25, and 30m, respectively.

The start was executed in an upright position 50cm in front of the first light gate. No command was given, and every tested individual started the test at an individually chosen point of time. Test-retest reliability of r = .94 - .98 (p < .05) is indicated for this test (Keiner, Sander, Wirth, Hartmann, Yaghobi, 2014).

Jump tests

The detection of jump heights and contact times of the jumps described below was carried out using a contact mat measuring system

(Refitronic, Schmitten, Germany) with an error in the time measurement < 0.15 according to the manufacturer. In the case of SJ and CMJ, 5 attempts per jump were carried out with an inter jump rest period of at least 30s. In the case of the DJ, 5 attempts were made for each height with the same intra- and inter-serial pause duration.

Squat Jump

The SJ was performed from a static starting position with knee flexion of about 90° with hands fixed at the hips and the upper body as upright as possible. Countermovements of any kind were not permitted. Wirth et al. (2016) state test-retest reliability of ICC = .88 for this test.

Countermovement Jump

To detect the slowly-reactively reached jump height, the CMJ was carried out by utilizing a countermovement from an upright starting position to a knee flexion of about 90° with hands fixed at the hips while keeping the upper body as upright as possible. This prevents support from swinging the arms or extreme torso propulsion. Wirth et al. (2016) state test-retest reliability of ICC = .93 for this test.

Drop Jump

The DJ was used to assess the fast-reactive strength. The tested drop heights were 16, 24, 32, 40, and 48cm, respectively. The subject stood upright on a box with hands fixed on the hips in the starting position. From this position, the subject started with a forward swing of a leg from the box and aimed to jump as high as possible after a short contact with the ground, paying attention to a bouncing jump execution. Ground contact times of ≥ 200ms, disengagement of the hands from the hips, ground contact of the heels during the take-off, or excessive joint angle enlargement in the knee and hip joint, led to an invalid jump. The reactive strength capability is represented by the reactive strength index (RSI). This was calculated according to Wirth, Sander, Keiner, Schmidtbleicher (2011) from the ground contact time and the jump height using the formula: RSI = jump height in mm / contact time in ms x 100. The test-retest reliability for the RSI from varying drop heights is ICC = .87 – .90 (Wirth et al., 2016) and is therefore classified as very high. Subjects were instructed to achieve a maximum jump height with minimal ground contact time. An exclusive request for maximum jump height may result in jump characteristics of the CMJ (Young, Pryor, Wilson, 1995), which is an acquisition of performance in the slow SSC and, therefore, would not be appropriate.

Statistical analysis

The data was analyzed with the use of SPSS 11.5 (SPSS, Inc., Chicago, IL, USA). Kolmogorov-Smirnov test was used to check for normal distribution. As this test revealed no significant result, Pearson's product-moment correlation was used to determine the strength of the relationships. The level of significance for all tests was set a priori to $p \leq .05$.

According to Keiner et al. (2014) the correlation coefficients were classified as follows: 0 = no correlation, $0 < |r| < .2$ = very weak correlation, $.2 < |r| < .4$ = weak correlation, $.4 < |r| < .6$ = medium correlation, $.6 < |r| < .8$ = strong correlation, $.8 < |r| < 1.0$ = very strong

correlation, 1 = perfect correlation.

Additionally, for CMJ and the DJ RSI with the greatest correlation to sprinting performance, the fastest and slowest fifty percent of the participants based on 30m sprint performance were compared via a two-tailed independent samples *t*-Test and Cohen's *d*. The effect sizes were classified according to Cohen (1988): $d > .2$ = small effect, $d > .5$ = medium effect, $d > .8$ = large effect.

RESULTS

The descriptive statistics are displayed in Table 1. For the sprinting sections, mean interval times between 0.768 ± 0.054s and 0.628 ± 0.062s were obtained, while the cumulative sprinting times showed means between 4.464 ± 0.343s and 1.095 ± 0.071s. The jumping tests revealed mean jumping heights of 31.95 ± 6.56cm in the SJ and 34.28 ± 7.47cm in the CJ, while the RSI in the drop jumps showed mean values between 155.11 ± 36.77 and 168.24 ± 36.29. Mean DJ RSI increased with increasing dropping height up to 32cm and showed a slight decline with further increases up to 48cm. The sample showed coefficients of variation between 6.44% and 7,68% for the sprinting times.

Table 1. *Descriptive data of the conducted sprint and jump tests*

	Mean	**SD**	**Min**	**Max**
T 5m [s]	1.095	0.071	0.947	1.256
T 10m [s]	1.863	0.120	1.661	2.139
T 15m [s]	2.546	0.173	2.258	2.955
T 20m [s]	3.201	0.228	2.822	3.737
T 25m [s]	3.836	0.288	3.373	4.509
T 30m [s]	4.464	0.343	3.910	5.271
T 5-10m [s]	0.768	0.054	0.680	0.883
T 10-15m [s]	0.683	0.055	0.593	0.816
T 15-20m [s]	0.654	0.056	0.564	0.782
T 20-25m [s]	0.639	0.059	0.551	0.772
T 25-30m [s]	0.628	0.062	0.537	0.762
SJ [cm]	31.95	6.56	17.60	49.30
CMJ [cm]	34.28	7.47	17.60	50.20
RSI 16	155.11	36.77	87.00	244.00
RSI 24	162.69	35.99	97.00	245.00
RSI 32	168.24	36.29	101.00	235.00
RSI 40	166.80	38.95	91.00	253.00
RSI 48	163.00	38.95	74.00	256.00

The calculation of the correlations between sprinting performance and jumping heights in the SJ and the CMJ revealed significant, strong correlations ($p \leq .01$) for all parameters, with a tendency for larger coefficients with increasing running distance (Table 2).

Table 2. *Correlations of sprint performance with jumping height in SJ and CMJ*

	SJ	CMJ
T 5m	-.671*	-.693*
T 10m	-.722*	-.746*
T 15m	-.741*	-.766*
T 20m	-.658*	-.652*
T 25m	-.763*	-.813*
T 30m	-.763*	-.793*
T 5-10m	-.723*	-.747*
T 10-15m	-.756*	-.783*
T 15-20m	-.769*	-.812*
T 20-25m	-.757*	-.805*
T 25-30m	-.790*	-.834*

Note: * = $p < .01$

The calculation of the correlations between sprinting performance and RSI in the DJ revealed significant, medium correlations ($p \leq .01$) for all parameters, with a tendency for larger coefficients with increasing drop height in the DJ (Table 3). The greatest correlation coefficients were obtained for a dropping height of 40cm.

Table 3. *Correlations of sprint performance with the RSI in the DJ*

	RSI 16	RSI 24	RSI 32	RSI 40	RSI 48
T 5m	-.379*	-.441*	-.454*	-.498*	-.403*
T 10m	-.412*	-.458*	-.504*	-.533*	-.437*
T 15m	-.424*	-.471*	-.524*	-.554*	-.458*
T 20m	-.425*	-.478*	-.542*	-.569*	-.476*
T 25m	-.418*	-.472*	-.530*	-.559*	-.449*
T 30m	-.431*	-.489*	-.561*	-.586*	-.497*
T 5-10m	-.415*	-.438*	-.521*	-.528*	-.441*
T 10-15m	-.434*	-.480*	-.550*	-.581*	-.485*
T 15-20m	-.410*	-.478*	-.572*	-.594*	-.519*
T 20-25m	-.413*	-.490*	-.566*	-.588*	-.484*
T 25-30m	-.434*	-.488*	-.552*	-.566*	-.468*

Note: * = p < .01

The comparison of the fastest and slowest 50% of the subjects revealed significant differences between the groups in both jumps, with the faster subjects showing statistically higher jumping performance (Table 4).

Table 4. *Comparison of the fastest and slowest participants.*

	Fastest 50%	Slowest 50%	p	d
CMJ	38.59	29.98*	.000001	1.40
RSI 40	180.93	155.48*	.006	.71

Note: ** = significant group difference*

DISCUSSION

The results from the present study showed consistently significant relationships ($p < .01$) between vertical jumping performance and sprinting performance up to 30m for the observed sample and an increase in the relationships with running distance.

The jumping heights in SJ and CMJ showed strong significant correlations for all sections. The values of the obtained coefficients were slightly lower than the ones obtained by Loturco et al. (2015) with competitive sprinters but clearly greater than the results of Kukolj et al. (1999), who also examined physical education students. One approach to explain the different results with similar participants might be the hypothesis that the participants of this study might have had lower differences regarding the movement pattern in the sprint so that the capacity to apply force on the ground gained relevance for the reached sprinting velocity.

Regarding the correlations of the RSI in the DJ with the different sprint section significant, medium coefficients $p < .01$) could be observed. The greatest correlations were obtained for a dropping height of 40 cm. The obtained relationships are in accordance with those of Cunha et al. (2007), who measured a coefficient of $r = -.684$ between sprint performance and RSI with a dropping height of 24 cm using a collective of participants with mixed performance level. Using a dropping height of 30cm, Hennessy & Kilty (2001) obtained an even greater relationship of $r = -.79$ ($p < 0.05$) with sprint performance up to 30m in active sprinters. Limiting the value of these comparisons, it is to note that the mentioned studies only used one dropping height to determine SSC performance. Since SSC performance shows a development towards an optimum when altering the dropping height (Komi, 2003, Schmidtbleicher, 1992), the performance of the observed collectives might have easily been over-or underestimated by Cunha et a. (2007) and Hennessy & Kilty (2001).

With increasing sprinting distance, an increase in the correlation coefficients with the RSI can be observed. In this regard, the increasing ground reaction forces with simultaneously decreasing ground contact times (Mann, Herman, 1985) are to be considered. This trend should let an increasing stretch velocity with the associated reflex mechanisms be expected. Additionally, the results by Ishikawa & Komi (2007) indicated a shift of the achilles tendon reflex's mechanical effect from the breaking phase to the propulsive phase of the ground contact with increasing running speed.

The comparison of the different dropping heights in the DJ showed that the greatest correlations were obtained using a height of 40cm. This might reflect the mean proficiency level of the sample and could reflect the optimum dropping height for the studied sample.

If the dropping height exceeds the individuals' optimum height, subtle changes regarding the movement pattern can be observed that manifest in greater joint movements of the knee and hip joints (Bobbert, 1990, Bobbert, Huijing, Van Ingen Schenau, 1987). This pattern serves to reduce the ground reaction forces that probably would exceed the individuals' capacity without altering the movement pattern. This hypothesis is emphasized by the observations of Bobbert et al. (1987), who obtained similar joint moments in the knee and hip joints for DJ with a dropping height of 20cm and 40cm, respectively, whereas the impulse and the vertical component of the ground reaction forces in the push-off rose with increasing dropping height. A further increase of the dropping height to 60 cm resulted in a decrease of all the mentioned parameters. Additionally, the authors stated that the participants were not able to prevent their heels from touching the ground anymore, which further underlines the conclusion that this dropping height exceeded the participants' capacity. Although these results of Bobbert et al. (1987) are limited in their power because the ground reaction times exceeded 200ms, which is why a fast SSC cannot be expected (Horita et al., 1996, Horita et al., 2002), they clearly provide evidence for the changes of the ground reaction forces with modified jumping patterns.

Considering the importance of the ability to produce a high amount of force in the horizontal plane for high sprint velocities (Morin et al., 2011, Morin et al., 2012), one might argue that DJ in a vertical motion does not reflect the necessary movement pattern. But despite the observation that horizontal force production is indeed highly important for sprint performance, the importance of vertical DJ performance still seems eligible. Since propulsion in the sprint from about 20m in the run is believed to be realized primarily via hip extension with great swing velocity (Bezodis, Kerwin, Salo, 2008, Hunter, Marshall, McNair, 2005, Seagrave, 1996), the main contribution of knee and ankle joints is the amortization of the ground reaction forces' vertical component (Hunter, Marshall, McNair, 2004, Hunter et al., 2005). To provide for this task while avoiding to high an amount of horizontal breaking forces, ideally, the knee and ankle joints are positioned nearly vertically stacked when contacting the ground slightly in front of the vertical projection of the center of mass (Hunter et al., 2004, Hunter et al., 2005).

The results of the correlational analysis are further supported by the exemplary comparisons of the fastest and slowest 50% in CMJ performance and DJ RSI from a dropping height of 40cm. Significant group differences could be observed in both cases, which underlines the need of a high SSC capacity for sprint performance.

CONCLUSION

The results of the present study indicate medium to strong correlations between vertical jumping and sprinting performance with a tendency to increasing relationships with increasing sprinting distance. For the investigated sample, the greatest relationships with DJ performance could be observed with a dropping height of 40cm. Whether this observation can be possibly underlined by the ground reaction forces in these two movements tasks, needs to be addressed by additional research.

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Corresponding author:

Sebastian Möck
Department of Exercise Science,
Olympic Training and Testing Center of Hessen,
Frankfurt am Main, GERMANY
E-mail: smoeck@lsbh.de

RELEVANCE OF VO_2max CONSUMPTION IN ELITE BULGARIAN TAEKWONDO COMPETITORS

Dimitar Avramov
National Sports Academy "Vassil Levski", Sofia, Bulgaria

ABSTRACT

The aim of this study was to determine aerobic fitness through the VO_2max treadmill test of elite Bulgarian taekwondo players with international results, and to determine whether the aerobic system had an effect upon the sports result in taekwondo. Fourteen elite taekwondo athletes, members of the Bulgarian national team (8 male and 6 female) were tested using a continuous progressive treadmill test. Physiological characteristics such as maximal oxygen uptake (VO_2max), blood lactate and heart rate were measured. The male athletes recorded 58.2±3.4 ml kg^{-1} min^{-1} and the female 46.0±2.8 ml kg^{-1} min^{-1}. The lactate level reached its highest at the 6' after the VO_2max with results for the males of 11.5±3.7 (mmol l^{-1}) and 9.9±4.1 (mmol l^{-1}) for the females respectively. A comparison between our results, regarding VO_2max and previously reported was made using the One-way Anova for independent samples. It showed no significant difference between the male subjects (58.2±3.4 versus 60.7±3.3 ml kg(-1) min(-1), p>.05) and significant difference between the female ones (46.0±2.8 versus 49.8±2.8 ml kg(-1) min(-1), p<.05). Investigated also was the number of kicks executed by the winner of -49 kg weight category and her direct opponents during the 2019 Grand Prix Sofia. It was discovered that the winner kicked an average of 86.25 times per match and her kicks during the Grand Prix Sofia accumulated to 390 in total. It is our conclusion that the aerobic fitness does not play a significant role in taekwondo.

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ORCID
Dimitar Avramov
https://orcid.org/0000-0003-4722-9905

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INTRODUCTION

Determining the primary energy source in every sport is vital for the optimization of the training process. In endurance sports it is of key importance to identify the type of endurance needed whether it will be aerobic, anaerobic or of mixed type. The most widely used aerobic capacity indicator is the maximal oxygen uptake (VO_2max), which is defined as the highest rate of oxygen consumption attainable during maximal or exhaustive exercise" (Dimitrova et al., 2019). The measurement of VO_2 max in a laboratory provides quantitative value of endurance for comparison of the individual training effect, as well as comparison of endurance between different athletes. In addition to the VO_2max testing, the measurement of blood lactate in sporting activities provides useful information to athletes, coaches and sports scientists for individualizing training programs and also for evaluating the effectiveness of the training programs (Kitagawa, 2010).

Taekwondo has been an Olympic sport for the past 21 years. Even though there are several competitive disciplines such as sparring (kyorugi), forms (poomsae) and breaking (kyokpa) only the first discipline is an official Olympic event. The sparring is also the most demanding of the three regarding the physiological functions of an athlete. Taekwondo matches usually consist of 3 rounds of 2 minutes, divided by 1 minute break between each. In order to win a gold medal, an athlete must win 5 or 6 matches during the World Championships (Results, World Taekwondo Championships, 2019). The matches are usually conducted in

one day which puts an enormous stress upon the body of the competitor. During the last two World championships (2017 Muju, 2019 Manchester) the final games for each category were scheduled for the next day in order for the athletes to have more time to recover and perform better. However, other championships, including the Olympics are held on one day.

Even though it is still debatable whether the aerobic energy system is of great consequence in taekwondo, few studies have been conducted on the topic of aerobic fitness in elite taekwondo athletes (Markovic, 2005, Rivera, 1998). Furthermore, most of the studies on the subject have been performed prior the changes in the rules regarding the electronic scoring system which has affected the dynamics and intensity of the taekwondo match drastically. That is why, we deemed necessary to examine the effect of these changes upon the athletes utilizing the most standardized and used test for aerobic endurance.

The aim of this study was to examine the maximal oxygen consumption in taekwondo players and its role in the sports result and to determine whether the new style of play, imposed by the changes in the competition rules of taekwondo, had an effect over the aerobic fitness of the athletes.

For that purpose, we compared our results regarding VO_2max test of taekwondo athletes with previously reported ones, acquired under the old competition rules. We also investigated the number of kicks performed during a taekwondo competition under both set of rules.

The taekwondo kicks rely on anaerobic power but there have been little attempts to standardize specific anaerobic endurance tests for taekwondo (Jader et al., 2014). Another problem is that there have been little to no consequential data of application of those tests. In a summary of all the physical and physiological data of taekwondo athletes available made by Craig et al. (2014) the Wingate test is the only non-specific test for anaerobic power done in taekwondo. Another problem presents the wide range of weight categories in taekwondo and the limited data reported for each category respectively.

Given the broad range of sports that use the maximum oxygen uptake test, it is relatively easy to compare the results from VO_2max between different sports. It is still debatable how instrumental for the taekwondo athlete the aerobic fitness is, but it is mandatory for Bulgarian national teams to undergo functional tests every year and the VO_2max test is the only functional test that is done for taekwondo athletes in Bulgaria.

MATERIALS AND METHODS

Participants

Fourteen Bulgarian national team athletes (8 male and 6 female) voluntarily took part in the study as a part of their annual testing. Each athlete signed an informed consent form before participation in the study. Ethical clearance was obtained from the Bulgarian Taekwondo Federation. The inclusion criteria for the participants were to be active members of the Bulgarian national taekwondo team, to have won medals from G ranking tournaments for seniors and/or juniors and to be in a condition to perform the test.

All participants had a minimum of 8+ years of experience (black belts) that trained 10 ± 2 sessions per week with mean age of 17.6 years; body height 174.3±7.7 cm for the males and 165.7±5.6 cm for the females; body mass 62.0±8.3 kg for the males and 55.7±6.7 kg for the females.

The subjects were in a basic preparation period and according to the annual periodization plan were training an average of 22 hours per week, with a weekly average of 8 hours spent on basic physical preparation, 8 hours spent

on specific physical preparation, 4 hours spent on technical preparation and 2 hours spent on psychological preparation.

All subjects and their parents (for those under 18-years-old) were informed in advance about the procedures of the study and asked to sign a term of consent according to the Declaration of Helsinki.

Testing procedures

The test was performed on the 12 and 13 of December 2019. The athletes were invited for two consecutive internship weekends for testing. This period coincided with the post competitive phase of the season and the basic preparation period. The testing was conducted between 10 a.m. and 2 p.m. each testing day.

Anthropometric measurements

Anthropometric measurements such as body mass, body height and 10 skinfolds (1. Skinfold on the cheek underneath the temple at the level of the tragus. 2. Under the chin above the hyoid hone. 3. On the chest in the anterior axillary fold. 4. On the back of the arm halfway between the acromion and olecranon. 5. On the back underneath the angle of the scapula. 6. On the abdomen in the first quarter of the distance between the anterior spike of the ilium and the umbilicus. 7. On the chest in the anterior axillary line at the level of the tenth rib. 8. On the side above the iliac crest in the prolongation of the anterior axillary line. 9. On the thigh above the knee. 10. On the calf below the popliteal fossa) were measured using a Harpenden caliper model HSK-BI (Great Britain). The percentage of body fat was estimated according to the method of (Parizkova, Buzkova, 1971).

% BF male = 22,32.log ΣX - 29,25
% BF female = 39,57.log ΣX - 61,25
where ΣX is the sum of the 10 skinfolds

Lean body mass was calculated by subtracting the estimated body fat from the total body mass.

Lean Body Mass (kg) = BW – BF

$$\text{Muscle mass \%} = \frac{\text{Body height x } (0{,}0553.CTC^2 + 0{,}0987.O\Pi^2 + 0{,}0331.CSC^2) - 2445}{1000}$$

CTC – Corrected Thigh Circumference FC – Uncorrected Forearm Circumference
CSC – Corrected Shin Circumference SF - Skinfold

$$CTC\ (cm) = \text{Thigh circumference} - \frac{2.\pi.\ SF\ thigh}{10}$$

$$CSC\ (cm) = \text{shin circumference}\ \frac{2.\pi.\ SF\ shin}{10}$$

$BF/weight_{kg}$ x 100 = $BF_{\%}$ $BF_{kg} = BF_{\%}$ x $weight_{kg}/100$

The testing session included anthropometric measurements, followed by maximal oxygen uptake (VO_2max test). For the treadmill test COSMOS h/p Venus (Germany) treadmill was used. The initial speed of the treadmill was 5 km/h and the speed was increased with 1.2 km/h at every 90 seconds until failure (exhaustion). The incline was at constant 2.5°. Gas exchange was monitored during and 10 min after the exercise. The attainment of VO_2max was validated if at least two of the following criteria were met: (1) reaching a plateau in VO_2max with an increase of the power output; (2) a respiratory exchange ratio ≥1.1; (3) the heart rate

approaches (±10%) the age-predicted maximal heart rate (220−ages) and (4) or volitional fatigue. Maximal oxygen uptake was defined as the maximal attained VO_2 at the end of the exercise period in which the subject reached exhaustion. Breath by breath gas exchange was measured continuously with Oxicon Pro (Yeger, Germany). Heart rate was recorded with POLAR RCX3. The recording started at rest and continued until 10 min post exercise (recovery period). Blood samples were taken from the fingertip to measure blood lactate with the use of an Accutrend Plus (Roche, Switzerland) at 2', 6' and 15'.

We also analyzed the number of kicks executed by the winner and her direct opponents in the female under 49 kg category at the 2019 Grand Prix Sofia.

Statistical analysis

All data were analyzed using SPSS, version 23.0 for Windows (IBM corp. Inc., Chicago, IL, USA, 2015.

Standard statistical methods were used for the calculation of means and standard deviations (SD) and Student's t criterion for independent samples. The differences between the male and female group were reported as mean difference ± 95% confidence intervals (meandiff ± 95% CI). One-way Anova for independent samples was used to determine the differences in VO_2max parameters between our results and previously reported ones. The $p<.05$ was considered as statistically significant.

RESULTS

The anthropometrical and body composition characteristics of the Bulgarian National team are presented in Table 1 as Mean Value and Standard Deviation. The results from the VO_2 max and lactate testing can also be seen there.

Table 1. *Anthropometric and functional characteristics of the Bulgarian national taekwondo team (Mean ± SD)*

Variable	Male	Female
Number of participants	8	6
Height (cm)	174.3±7.7	165.7±5.6
Range	176.3±8.6	162.5±5.3
Body mass (kg)	62.0±8.3	55.7±6.7
Lean Body Mass (kg)	56.8±7.5	46.3±3.9
% Body fat	8.0±2.5	16.4±3.3
Body fat (kg)	5.2±1.5	9.3±2.9
% Muscle mass	47.9±2.1	41.9±2.1
Muscle mass (kg)	29.8±4.8	23.2±2.2
S max	15.1±1.1	11.7±0.6
VO_2max	3603.1±433	2568.1±353.0
VO_2max/kg	58.2±3.4	46.0±2.8
HR max	195.1±7.6	191.5±6.4
La 2'	9.0±3.0	7.9±3.4
La 6'	11.5±3.7	9.9±4.1
La 15'	7.8±5.3	7.0±3.3
HR 2'	145.8±17.6	146.7±9.5
HR 6'	98.3±14.4	102.2±8.2

Table 2 presents the age and body composition obtained by us compared to a previously published data. It must be noted that Heller (Heller et al., 1998) tested taekwondo athletes from the International Taekwondo Federation, which differs from the Olympic style Taekwondo in terms of competition rules – hence – the difference in the obtained results.

Table 2. *Age and body composition of female taekwondo athletes (MEAN ± SD)*

Variable	Bulgarian National Team	Croatian National team (Markovic et al., 2005)	Czech National team (Heller et al., 1998)	Olympic Puerto Rican athletes (Rivera et al., 1998)
No. of athletes	6	13	12	9
Age (years)	17.6±0.5	21.5±4.1	18.5±2.6	18.1±3.4
Body mass (kg)	55.7±6.71	60.1±9.0	62.3±7.4	58.6±11.2
Body height (cm)	165.7±5.6	168.0±6.6	168.0±5.0	163.7±6.9
Body fat (%)	16.4±3.3	16.5±2.7	15.4±5.1	18.3±5.6
Lean body mass (kg)	46.3±3.9	49.9±5.8	52.4±4.2	-

The use of weight categories in taekwondo supposes that the athletes should have lower percentage of body fat. It is important in which period of the yearly cycle the athletes have been tested since the weight in the preparatory and in the competition period differs significantly. The Bulgarian athletes were tested in December when the competitive period was over and they were into a basic preparation. The tested Bulgarian female athletes are in the lower weight categories (49, 53 and 57 kg).

The female physical characteristics are comparable to the ones Markovic et al. (2005) have reported. However, Markovic divided his test subjects to two groups – A and B. In A were the athletes with significant international results. When compared to them the Bulgarian athletes are with lower indicators.

Table 3. *Age and body composition of male taekwondo athletes (MEAN ± SD)*

Variable	Bulgarian National Team	Turkish elite (Khayyat et al., 2020)	Czech National team (Heller et al., 1998)	Olympic Puerto Rican athletes (Rivera et al., 1998)
No. of athletes	8	12	11	13
Age (years)	17.0±1.3	22.7±2.8	20.9 ± 2.2	22.3±7.1
Body mass (kg)	62.0±8.39	72.9±6.9	69.9 ± 8.7	67.1±11.8
Body height (cm)	174.3±7.7	182.0±0.4	179 ± 6	171.2±5.8
Body fat (%)	8.0±2.5	12.8±3.4	8.2 ± 3.1	9.6±2.7
Lean body mass (kg)	56.8±7.5	N/A	64.2 ± 6.7	N/A

For body composition comparison we deem proper certain category to be compared and examined in terms of height and body fat. However, such a research has not been performed. Bulgarian athletes have the lowest body fat percentage compared to the other tested subjects described. The tested competitors are however of the lower weight categories (54, 58, 63, 68 and 74 kg) which can also be seen in Table 3.

Table 4. *Functional characteristics of elite female taekwondo athletes (Mean ± SD)*

Variable	Bulgarian National Team	Croatian National team – All (Markovic et al., 2005)	Croatian National team Elite (Markovic et al., 2005)	Czech athletes (Heller et al., 1998)
VO_2max (l min-1)	2.5 ± 0.3	2.9 ± 0.5	3.1 ± 0.5	N/A
VO_2max (ml.kg-1.min-1)	46.0 ± 2.8	48.3 ± 2.8	49.6 ± 3.3	41.6 ± 4.2
Maximum Heart rate	191.1 ± 6.4	N/A	N/A	188 ± 8

Table 4 presents the obtained data for VO_2max of female taekwondo athletes. In terms of the number and level of participants, and the method of testing (Treadmill test), the investigation performed by Markovic et al., 2005 resembles ours the most. That is why, we compared our results to his findings.

Table 5. *Mean values of the surveyed indexes for the Bulgarian and Croatian female national teams (Mean ± SD)*

Variable	N	VO_2max (ml.kg-1.min-1)	temp	P(t)
Bulgarian National team	8	46.0 ± 2.8	2.44	98.00
Croatian National team	7	49.8 ± 2.8		

A significant difference was discovered between the Bulgarian and the Croatian female athletes (Table 5). The Bulgarian female athletes had lesser VO_2max uptake than their Croatian counterparts but they are much younger, which we consider to be one of the main reasons for that difference (Bulgarian female athletes 17.6±0.5 years versus Croatian female athletes 21.5±4.1 years).

Table 6. *Functional characteristics of elite male taekwondo athletes (Mean ± SD)*

Variable	Bulgarian National team	Division I (Chen et al., 2006)	Czech National ITF team (Heller et al., 1998)	Olympic Puerto Rican athletes (Rivera et al., 1998)
VO_2max (l min-1)	3.6±0.4	N/A	N/A	N/A
VO_2max (ml.kg-1.min-1)	58.2±3.4	53.1±2.0	53.9±4.4	59.3±4.5
Maximum speed (km h-1)	15.1±1.1	N/A	N/A	14.9±0.7
Max Heart rate (beats min-1)	195.1±7.6	195.3±2.8	183±6	171.0±8.2

Regarding the male oxygen uptake, a comparison was made with the oxygen uptake reported by Drabik (1995) which was closest to ours in terms of the number and level of participants, and the method of testing (Treadmill test).

Table 7. *Mean values of the surveyed indexes of the Bulgarian and Polish male national teams (Means ± SD)*

Variable	N	VO_2max (ml.kg-1.min-1)	temp	P (t)
Bulgarian National team	6	58.2 ± 3.4	1.44	82.00
Polish National team (Drabik 1995)	7	60.7 ± 3.3		

We found no statistical difference in the compared results (Table 7). There are few published studies involving elite national team athletes from top countries in taekwondo regarding VO_2max. There are even fewer studies published since the major changes in the competition rules. We deemed necessary to interpret the aerobic endurance in relationship to the taekwondo activity during a match.

In terms of special endurance, we deemed correct to interpret any results from standardized tests to specific workload. That is why, we chose to investigate the number of kicks executed in a taekwondo match.

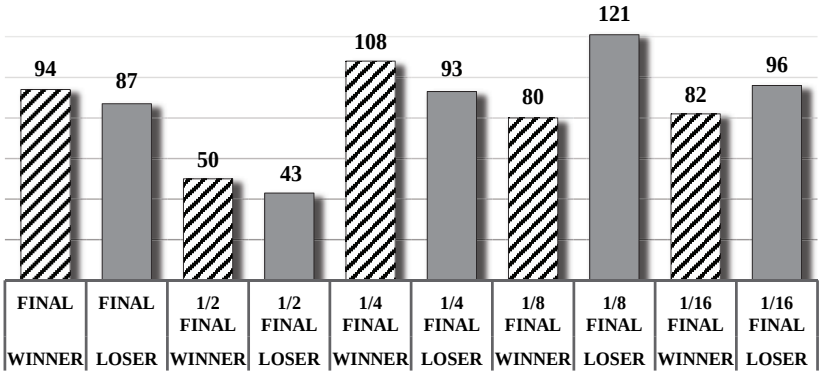

Figure 1. *Total number of kicks and punches in a taekwondo match*

We managed to count the total number of kicks and punches for the 49 kg female weight category winner at the 2019 Grand Prix Sofia. The results are presented in Figure 1. Compared to previously reported values by Markovic et al. (2008) and Falco et al. (2012), ours were 3 times higher.

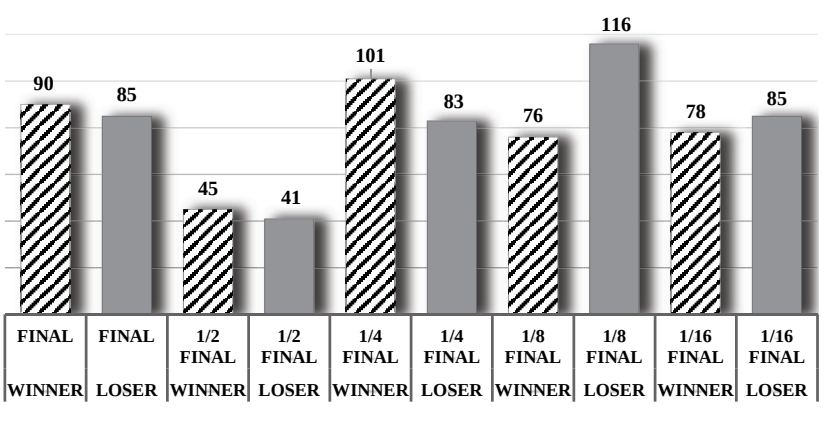

Figure 2. *Total number of kicks performed in a taekwondo match*

Since the main tool for scoring points in Olympic taekwondo is kicking it is important to know how many times per match a competitor is doing it. Figure 2 presents the number of kicks the winner of the -49 kg female weight category executed in all her games during Grand Prix Sofia 2019. The types of kicks used is not relevant to the present study and that is why we have not included them in here. Bear in mind that during the semi-final of Grand Prix Sofia between the winner and the loser, the latter had an injury and the total three rounds of the match were not played. We have not included that match in the average numbers.

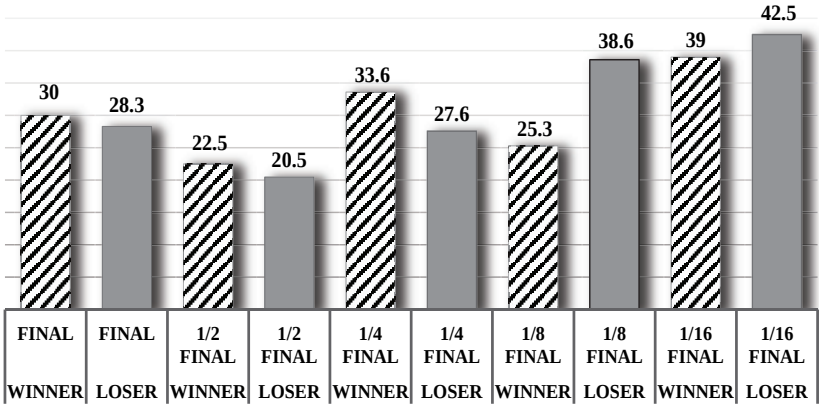

Figure 3. *Average number of kicks per taekwondo round*

Figure 3 clearly shows that the number of executed kicks in a modern taekwondo fight has grown significantly than previously reported values. The number of kicks in a single round in modern taekwondo equals those reported by Markovic et al. (2008) and Falco et al. (2012) for an entire match.

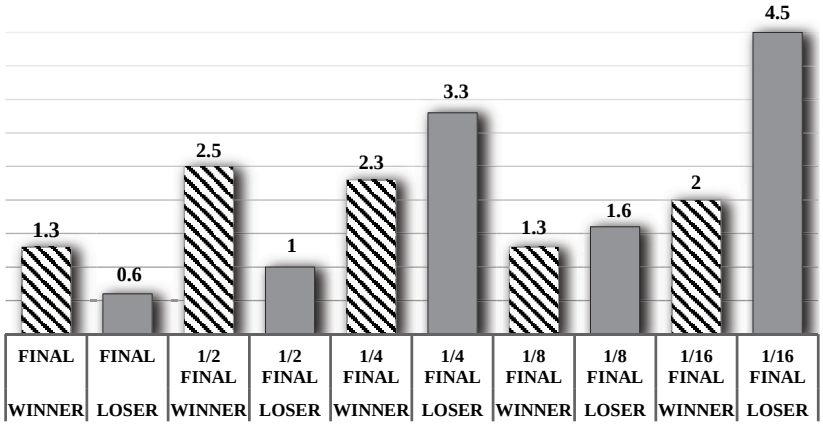

Figure 4. *Average number of punches per taekwondo round*

Punching is still the only hitting technique in taekwondo that is scored by the referees and it is very subjective whether a referee would award it or not. The numbers shown in Figure 4 suggest that punching is still not widely used in modern taekwondo but further investigation is needed as to establish the influence punching techniques play over the sport result in taekwondo.

DISCUSSION

Markovic et al. (2005) consider that ade-

quate aerobic capacity is indispensable because it enables relatively fast recovery between rounds and fights and also facilitates faster recovery during and after a training session. However, Elliot et al. (2007) state that "…the development of LIEE (Low Intensity Exercise Endurance) in sports that rely on anaerobic endurance supply (e.g., sprinting, American football, ice hockey, volleyball) can result in maladaptation that reduces an athlete's performance capacity". Bompa, Buzzichelli (2015) suggests the following information regarding the bioenergetic characteristics for some sports.

Table 8. *Energy Delivery Systems (Ergogenesis in Percentage) for Sports*

Sport	Event or position	ATP + Creatine phosphate	Glycolytic	Oxidative	Reference
Athletics (track and field)	200 m	26	45	29	(Someren, 2006) and Newsholme et al. (1994)
	400 m	12	50	38	(Someren, 2006) and Newsholme et al. (1994)
	800	6	33	61	(Someren, 2006) and Newsholme et al. (1994)
Judo		90	10	0	(Dal Monte, 1983)
Wrestling		45	55	0	(Powers and Howley, 2004)

One of the biggest misconceptions conditioning coaches have about taekwondo is to compare the 2-minute taekwondo round to a track and field event with the relatively same duration, most often 800 m dash. Very often only the duration of the events is taken into the consideration. However, during the 800 m the load of the event is constant and of a submaximal intensity while during the taekwondo round there are short bursts of energy (kicks, punches, slides or steps, blocking, pushing), preferably with maximum intensity, which last from less than 1 second (0.498 ± 0.021s) (Estevan 2013) for 1 kick to a combination of 3-4 kicks the most (4-5 seconds). This is followed by a period of a relative rest (bouncing or standing still and/or preparing for the next attack). There are also the breaks in the game which are inevitable – from 5 seconds (when there is a penalty to be given to a competitor), to a 1-3 minute when a coach has requested a video replay.

Elite female taekwondo athletes have been reported to deliver an average of 32.1 kicks in a taekwondo bout (Markovic et al. (2008). Falco et al. (2012) reports between 28.4 and 34.25 of kicks for the different categories for the male and between 26.5 and 45.17 for the female categories in 2011 Spanish University championships. We considered these numbers to be outdated having in mind that there have been significant changes in the competition rules of taekwondo (World Taekwondo, 2019; World Taekwondo Federation, 2009). That consideration was confirmed by our results and given the number of kicks that we have reported – an average of almost 90 per match per athlete (M = 89.25). This equals to around 1 kick per every 4 seconds in a taekwondo match. In reality those numbers (depending on the type of kicks) accumulate relatively to 45 seconds of High Intensity Movements during a taekwondo match regarding the number of kicks.

It is obvious that Taekwondo relies primarily on power and speed endurance since it incorporates high power outputs and repeti-

tive performance of high velocity movements (kicks). The ability to sustain and repeat high intensity exercise bouts is termed high-intensity exercise endurance (HIEE) (Stone et al., 2006). Not only is HIEE or interval training approach beneficial to and does not impair the force generating capacity (Bompa, Buzzichelli, 2015), but it can also be beneficial to aerobic endurance or LIEE (Laursen, Jenkins, 2002). This means that taekwondo athletes will develop the needed aerobic capacity even if they perform High Intensity Interval Work with the sport specific exercises.

CONCLUSION

Speed and Power endurance is inevitably linked to the anaerobic system. However, according to proposed models for a training microcycle in power dependent sports (Bompa, Buzzichelli, 2019), the alternation between lactic, alactic and aerobic system is inevitable. This can be incorporated in taekwondo when the aerobic energy system is taxed during technical and tactical trainings, especially when using a partner if the intensity of the exercises is not high and/or after a heavy load day. The specifics of taekwondo trainings even for elite athletes include numerous repetitions of a skill both technical and/or tactical. Those can be done on the aerobic days serving a double function – first to develop the new skill and second to recover the energy system (either alactic or lactic).

The results from the VO_2max test regarding the Bulgarian and the previously reported Polish national team male athletes (Drabik, 1995) suggest that the aerobic capacity has not changed in the taekwondo athlete. We presume that this is due to the fact that the aerobic capacity does not play a significant role in the preparation of a taekwondo competitor.

In terms of the female athletes, even though there is a statistically significant difference between the two groups, we consider this mainly due to the fact that the Bulgarian athletes are much younger than their Croatian counterparts and not because the aerobic fitness plays an important role in the preparation and the consequent success of a taekwondo female competitor. Furthermore, given the number of kicks reported by us and the values of the VO_2max test it is our conclusion that aerobic endurance is not an important factor of the sports result in taekwondo. It is a secondary quality and is developed during the technical and occasionally tactical training. That is why we consider that there is no need in the additional development of that quality in elite taekwondo athletes.

We recommend that instead of aerobic VO_2max test a specific anaerobic test is developed in order for elite Bulgarian taekwondo athletes to be tested accordingly. Furthermore, we recommend that coaches plan the testing of aerobic and/or anaerobic endurance before and after the planned period for the considered physical quality which has not been the case in the Bulgarian national taekwondo team so far.

LIMITATIONS

The number of participants in the present study is a limitation. There are also insufficient data in relation to the different weight categories in taekwondo and the corresponding level of physical abilities required for them which presents another limitation in terms of interpretation of the results. In order to obtain best results, the regular testing for the national taekwondo team must be planned according to the training plan and performed before and after the period designated for the development of the specific motor ability. This has not been done so far. There are very few publications regarding elite taekwondo athletes and their motor abilities which is another limitation encountered.

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Corresponding author:

Dimitar Avramov
"Wrestling and Judo" Department
21, Acad. Stefan Mladenov str.
Studentski grad, 1700
Sofia, Bulgaria
E-mail: mitkoave@yahoo.com

RELATIONSHIPS BETWEEN AEROBIC AND ANAEROBIC CARDIOPULMONARY INDICES OF YOUNG MALE SOCCER PLAYERS WHEN PERFORMING LABORATORY FUNCTIONAL TESTS

Borislava Petrova

National Sports Academy "Vassil Levski", Sofia, Bulgaria

ABSTRACT

Soccer is a high-intensity intermittent team sport where both the aerobic and anaerobic energy systems contribute to the physiological demands of the game. The study aims to search and determine relationships between the values of cardiopulmonary and gas exchange indices during frequently used laboratory tests - the CardioPulmonary Exercise Test (CPET) and the Wingate Anaerobic Test (WAnT), exploring the capacity of the energy systems. Forty-seven soccer players (15.06 ± 0.84 years of age) performed both tests as Oxygen uptake (VO_2), Oxygen pulse (O_2HR), Pulmonary ventilation (VE), Volume of expired air (VTex), and Breath frequency (BF) were measured online using a breath-by-breath cardiopulmonary exercise testing system. Ergometric achievements during WAnT: PP (Peak Power) 662.4 ± 121.2 W; AP (Average Power) 494.67 ± 98.5 W; FI (Fatigue Index) 61.2 ± 28.7%. There was no correlation between WAnT PP and AP and maximum power output in CPET. WAnT VE and VTex correlate significantly with CPET VO_2max (r = .676 and r = .772, respectively). The main finding was a presence of approximately identical maximal values of cardiopulmonary parameters achieved in the very different in duration and intensity CPET and WAnT: insignificant differences between CPET versus WAnT: VO_2max (55.97 ± 2.02 versus 56.02 ± 17.3 ml.kg.min^{-1}); VEmax (133.96 ± 21.77 versus 126.77 ± 24.77 l.min^{-1}); VTex max (2.19 ± 0.37 l versus 2.06 ± 0.43 l); BFmax (62.20 versus 75.43.min^{-1}). We assume that when conducting WAnT with simultaneous registration of respiration, together with the indices of athletes' power output, reliable information about the magnitude of VO2max and other cardiopulmonary parameters of players could be obtained. This will greatly facilitate the ongoing control of the exercise conditioning status of athletes.

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ORCID
Borislava Petrova
https://orcid.org/0000-0002-2128-2110

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INTRODUCTION

Soccer is the most popular game in the world, which men and women of all ages practice both in the form of highly emotional entertainment and as a highly qualified sport. The modern methodology of sports training begins at an early age when the mastery of sports techniques is particularly successful. At the same time, however, training effects are carried out to increase the functional capabilities of the body of the athletes. The training programs focus on the specific features of the given sport, especially on the nature of the motor abilities, structure, and intensity. The latter determines the participation and activity of energy delivering systems needed for the physical effort.

McMillan (2005) classified soccer as a high-intensity intermittent team sport with an acyclic structure. During competitive soccer match play, elite players cover a distance of

about 10–12 km at an average intensity close to the anaerobic threshold, being 80–90% of maximal heart rate (HR max) or 70–80% of maximal oxygen uptake (VO_2max). VO_2max is considered to be the most important component of endurance performance. It has been found that aerobic metabolism provides 90% of the energy cost of soccer match play (Bangsbo,1994). Therefore, high aerobic capacity is crucial for successful performance during a football match. Aerobic endurance is one of the main fitness components important for success in soccer (Helgerud J et al., 2001) which observed a significant correlation between maximal oxygen uptake and distance covered during a soccer match (Hoff, 2005).

Soccer is characterized by frequent changes of intensity, short breaks recovery, sudden stops, and changes of direction, i.e., athletes make efforts of intermittent nature in training and competition. During a soccer match, young soccer players perform approximately 10–15 seconds of sprints (5, 10, and 20 m) every 90 seconds of the game (Stølen et al., 2005). The energy requirement is met by involving the anaerobic metabolism (Da Silva et al., 2010). It is noteworthy to mention that anaerobic fitness during growth and development has not received the same attention from researchers as aerobic fitness is.

Bangsbo et al. (2005) underline that both the aerobic and anaerobic energy systems contribute to the physiological demands of the soccer game. The anaerobic system is considered to be of great importance to perform ballistic movements such as sprinting, jumping, and changing direction rapidly (Stølenet al., 2005). These actions repeated over time (speed-strength endurance) at high intensity determine the high lactate concentrations. In this perspective, the aerobic system is crucial in increasing the lactate removal rate during the phases performed at lower intensities (Di Giminiani, Visca, 2017, Glaister, 2005, Spencer et al., 2005).

Detailed information about one's maximal aerobic capacity (VO_2max) and anaerobic power can be obtained by valid and reliable laboratory methods. The VO_2max of the athletes is determined by progressive intensity and continuous effort treadmill protocols or pedaling on a stationary bicycle, validating the respiratory anaerobic threshold and the respiratory exchange ratio (RER) as well. Most popular are the Cardiopulmonary Exercise Tests (CPET).

The athlete's anaerobic power and capacity are defined by the Wingate anaerobic test (WAnT), a 30-s all-out test where the work done is used to measure the anaerobic capacity. It provides information about both the alactic and lactic anaerobic energy transfer systems.

It should be born in mind that not only the development of a high level of physical work capacity is the single indicator of a successful player but represent the fundamental prerequisite of game performance (Chamari et al., 2004).

The scientific literature abounds in data on the level of aerobic and anaerobic capacity of elite athletes in various sports, the applied training methods, but research in adolescents is significantly limited (Armstrong, Welsman, Chia, 2001, Vanderford, 2004, Armstrong, Welsman, Chia, 2001, Vanderford, 2004).

The present study aimed to search and determine the relationships between cardiopulmonary and gas exchange indices during frequently used laboratory tests: CPET and WAnT. We hypothesized the existence of interconnections between the anaerobic and the aerobic physiological parameters recorded during the maximal cardiopulmonary exercise test (CPET) and the Wingate anaerobic test (WAnT). Establishing the presence of interrelationships will allow a more in-depth interpretation of the experimental results.

METHODOLOGY

Participants

Forty-seven adolescent soccer male players were studied (15.06 ± 0.84 years of age; height 172.91 ± 7.76 cm; body weight 60.11 ± 8.63 kg; BMI 20.13 ± 1.77) who were familiar with exhaustive exercises, volunteered to participate in this study. The subjects were fully informed of the details and discomfort associated with the experiments before they and their parents gave their informed consent to volunteer. Medical professionals seek information on any disease they might have before, their present health status, and any medication they could have taken. The following constituted the exclusion criteria: current infection, history of chronic disease, use of antibiotics, herbal, antioxidant, and steroid-containing supplements. The study protocols were conducted by the Helsinki Declaration for Ethical Treatment of Human Subjects and were evaluated and approved by the Ethics Committee of National Sports Academy, Sofia, Bulgaria.

Limitations

Blood lactate samples were not taken after the cessation of the exercise. Boys are characterized by lower lactate peak levels and shorter time lag before reaching it. Children generally observed faster performance recovery following short, high-intensity exercise. It is considered that children are better equipped for physical exercise supported by oxidative metabolism.

Exercise testing procedures

All study procedures were done in the High-Performance Physiology Laboratory at the Center for Scientific and Applied Research in Sport, National Sports Academy "Vassil Levski" Sofia. At the time of the study, the soccer players were in their competition phase of the annual training cycle 2017-2018. The training plan included evenly distributed work for aerobic and anaerobic endurance. The players train systematically for 5 years, five times a week, once a day.

Participants were tested twice in two separate sessions with an interval of 48 hours between sessions. During the first visit to the physiology laboratory, anthropometric measurements were made on the soccer players, after which they performed a cardiopulmonary exercise test (CPET) to measure maximal aerobic power (VO_2max). In the second session, the 30-second WAnT was carried out.

Bioelectric Impedance (In Body 230) was used to measure body weight (to the nearest 0.1 kg) and body composition and portable stadiometer (SECA, 225 UK) for stature (to 0.1 cm).

A maximal CPET was used to measure VO_2max: initial treadmill speed 6 km.h^{-1}, step length 90 seconds, speed increase 1.2 km.h^{-1}, constant incline 2.5^{o} (Iliev, 1970). The test was stopped when a participant could not continue running at the actual velocity and slope. Strong verbal encouragement was provided to each participant as they came to the end of the CPET. Oxygen uptake (VO_2), carbon dioxide output (VCO_2), oxygen heart rate (O_2HR), pulmonary ventilation (VE), the volume of exhaled air (VTex), and breath frequency (BF) were measured online using a breath-by-breath cardiopulmonary exercise testing system (Oxycon Pro, Jaeger-Pro, Germany). Before each test, the gas analyzer was calibrated with known certified gas concentration.

During CPET, heart rate (HR) and oxygen pulse (O_2HR) were monitored continuously using a wireless HR monitor (Polar RS800 SD, Finland) and were synchronized in time with the ventilatory signals.

30-Wingate anaerobic test

The 30s WAnT was performed on a mechanically braked cycle ergometer (Monark,

894 E, Stockholm, Sweden) as described by Inbar et al. (Inbar, 1996).

The following variables were determined: peak power output (PP), average power output (AP), and anaerobic fatigue index (FI). PP was the highest power generated during the test; AP was calculated as the average power during the entire 30-s period of the test. The FI was calculated as the percentage of power output drop from the maximal power output throughout the trial.

In addition, the subjects were connected to a portable gas analyzer Meta Max 3B, Cortex, Leipzig to allow the respiratory parameters to be recorded simultaneously with the power output realized during the test.

The test started with a standardized warming up of 5 min cycling at 60 W and 60 rev/min, including two sprints, each lasting 3 sec, performed at the end of the 3rd and the 5th min. The seat height and handle were individually adjusted for the subject's comfort, with the legs being nearly fully extended during each pedal revolution. After 5 min rest, the subjects were instructed to pedal as fast as possible throughout the 30-sec test. A resistance corresponding to 7.5% of the body mass was applied after an acceleration phase lasting 5s. Verbal feedback for the time remaining was provided at 15, 10, and 5 sec and verbal encouragement was given through the test. The subjects continued pedaling after completing the test with no load for several minutes to cool down.

Statistical analysis

The SPSS 19 (IBM, USA) was used for all statistical analyses. Data are presented as mean ± SD. The assumption of normality was tested with the Kolmogorov-Smirnov test on each variable. The level of statistical significance was set at $p < .05$. A Pearson product-moment correlation was used to determine the relationship between variables among the two tests. Magnitude of correlation was qualitatively ranked according to as follows: $r \leq .1$, negligible; $.1 < r \leq .3$, week; $.3 < r \leq .5$, moderate; $.5 < r \leq .7$, strong; $.7 < r \leq .9$, very strong; and $r > .9$, almost perfect.

RESULTS

The recorded anthropometric data of the investigated subjects are placed in Table 1.

Table 1. *Anthropometric characteristics of the soccer players (n=47)*

Parameter	Mean	SD
Age (years)	15.06	.84
Height (cm)	72.91	7.76
Weight (kg)	60.11	8.63
BMI (kg.m^{-2})	20.13	1.97
FFM (kg)	55.4	7.87

BMI - Body Mass Index; FFM – Free Fatty Mass

Eighteen of the studied group participants were 14 years old, fourteen were fifteen years old, and 15 were 16 years old. In all three cases, the distribution was normal, and the differences in the values of the studied parameters were most often statistically insignificant. This gave us reason to interpret the experimental results obtained simultaneously for the whole group of 47 players.

Table 2 represents the power achieved during the WAnT.

Table 2. *Ergometric indices achieved during the performance of WAnT (n=47)*

Parameter	Mean	SD
PP(W)	662.38	112.22
PP (W.kg^{-1})	11.25	2.63
AP (W)	494.68	98.55
AP (W.kg^{-1})	8.22	.99
FI%	61.2	28.72

PP –Peak Power; AP –Average Power; FI% - Fatigue Index

As already noted, when performing the WAnT, the subjects were connected to a portable gas analyzer to allow the respiratory parameters to be recorded simultaneously (breath by breath) with the power output realized during the test. Furthermore, it provides power output and O_2 consumption to be registered for every second during various segments of the test duration. The data established are presented in Table 3.

Table 3. *Cardiopulmonary data during the performance of WAnT (n=47)*

Indices	Average	SD	Indices	Average	SD
Time (s)	30	30	**O_2HRmax (ml)**	16.28	4.31
Wmax	662.38	112,2	**VEmax (L.min^{-1})**	126.77	24.27
VO_2max (ml.min^{-1})	3363.77	859.4	**VTexmax (L)**	2.061	0.43
VO_2max (ml.kg^{-1})	56.02	17.3	**BFmax.min^{-1}**	75.43	13.45
HR (B.min^{-1})	184.26	8.95	**RER**	1.18	.09

VO_2max –Maximal Oxygen Consumption; HR – Heart Rate; O_2HR – Oxygen Heart Rate;VE – Pulmonary Ventilation; VTex –Tidal Volume Expired; BF – Breath Frequency; RER – Respiratory Exchange Ratio

Based on these data, there were calculated ergometric and respiratory indices reflecting the relative share of participation of anaerobic and aerobic energy systems in the implementation of the Wingate test (Table 4). The calculation of these data was performed according to the method proposed by Stefanova and Petrova (2017) for analysis of the Wingate test results.

Table 4. *Calculated ergometric and respiratory indices achieved in the WAnT (n=47)*

Indices	Average	SD	Indices	Average	SD
W 30 s	14263.1	2568	**O_2 excess (ml)**	212.9	102.6
VO_2 30 s (ml)	1067.9	175.8	**W anaerobically**	4566.5	1858
O_2 deficit (ml)	224.2	90.2	**W anaerobically % to W 30s**	31.9	10.8

W30 s - Total Power Output 30 s; VO_2 30 s – Total O_2 Uptake 30 s'; W Anaerobic - Watts Performed Anaerobically

The maximum values of the cardiopulmonary parameters achieved during the performance of CPET on the treadmill are presented in Table 5.

Table 5. *Cardiorespiratory maximal responses data during performance CPET (n=47)*

Indices	Average	SD	Indices	Average	SD
Time (s)	737.59	73.46	**O_2HRmax (ml)**	17.05	2.88
Wmax	231.22	40.64	**VEmaxL.min^{-1})**	133.96	21.77
VO_2max (ml.min^{-1})	3448.2	513.43	**VTex max (L)**	2.19	.37
VO_2max (ml.kg.min^{-1})	55.97	2.02	**BFmax.min^{-1}**	62.20	7.99
HRmax B.min^{-1}	203.72	8.16	**RER**	1.15	.06

Table 6 presents the correlations between the ventilator and cardiopulmonary parameters during the performance of CPET and WAnT.

Table 6. *Correlations between ventilatory and cardiopulmonary parameters achieved during performance WAnT and CPET (n=47)*

WAnT	CPET	r	WAnT	CPET	r
VEmax (l.min^{-1})	VEmax (l.min^{-1})	.665	**VTex (l)**	VEmax (l.min^{-1})	.623
	VO_2max (ml.kg.min^{-1})	.676		BTex (l)	.809
	O_2HRmax (ml)	.665		O_2HRmax (ml)	.664
	VTex (l)	.536		VO_2max (ml.kg.min^{-1})	.772

Correlations are significant at the .001 level (2-tailed)

DISCUSSION

At the time of the study, the soccer players were in their competition phase of the annual training cycle 2017-2018. The training plan included evenly distributed work for aerobic and anaerobic endurance. They train systematically for 5 years, five times a week, once a day.

The present study aimed to investigate some relationships between the values of aerobic and anaerobic indices when performing the most commonly used laboratory tests for their determination: the CPET and the WAnT. Therefore, we focus first on the main indicators based on which the quality of the test performance is determined.

The measurement of VO_2max is commonly used to monitor athletes' training status and can help determine the training regime. Enhanced aerobic endurance in soccer players improved soccer performance by increasing the distance covered, enhancing work intensity, and increasing the number of sprints and involvements with the ball during a match (Helgerud et al., 2001). The analysis of the respiratory gas exchange with cardiopulmonary exercise tests provides the opportunity to assess the cardiovascular and pulmonary responses to metabolic stress created during exercise (Edwards et al., 2003, McMillan et al., 2005).

The data presented in Table 5 shows that the soccer players covered two of the criteria for reaching the maximal oxygen consumption: the actual HRmax was 100.04% from the expected, and the Respiratory Exchange Ratio (RER) was 1.15.

At the end of lasting an average of 12-minutes of CPET (Table 5), the young players reach a maximal aerobic capacity close to that of qualified players. The average VO_2max for international level male soccer players has been reported to range between 55 and 68 ml.kg.min^{-1} (Hoff, 2005). Ciprian and Vojtech

(2011) established 62.9 ± 5.12ml.kg.min^{-1} VO_2max in 17 years old soccer players; Tønnessen et al. (2012) reported VO_2max values ~62-64 ml.kg.min^{-1} for adolescent soccer players.

The average measured HRmax of the investigated soccer players corresponds to the Fox prediction equation (HRmax = 220-age). The data published by Gharbi et al. (2015) – 197 ± 8.7and Nikolaidis (2015) – 200 ± 7.9 beats per min are similar to those of the adolescent soccer players.

The values of the ventilatory parameters do not differ from those established by other researchers in the CPET.

VO_2max of performers of the CPET in this study (55.97 ± 2.02 ml.kg.min-1) differ slightly from those experienced with adult athletes. The values for VO_2max in the current study were significantly higher than values reported for the general population of the same age (Vanden and Eynde, 1988). This aerobic capacity is reached at a maximum power output equal to 231.22 ± 40.64 watts. It was reported VO_2max was 62.9 ± 5.12 ml.kg^{-1} for 17 years old soccer players (Ciprian and Voitech, 2011) and 62-64 ml.kg^{-1} for adolescent soccer players (Tonnessen et al., 2012).

The anaerobic profile of the participants in this study (Table 2) was superior to the general population. Peak and Average Power achieved from adolescent soccer players are close to data published by other authors (Armstrong, 2001, Stole et al., 2005, Üçok,2005, Cipryan, Gajda, 2011, Gharbi et al., 2015). Since the test aims to determine the anaerobic ability of the person, it is of particular importance to determine the relationship between oxygen deficit (as a marker for anaerobic power) and the excess amount of oxygen needed during the test performance to pay off the deficit (Table 4). Data of the Watts values obtained when performing the anaerobic component and the percentage contribution to the Total power output (W30 s) can also be added to the Wingate ergometric data. The applied methodology of simultaneous registration of ergometric and cardiorespiratory indicators makes it possible to determine the oxygen needs for physical exertion at any time of the load and hence the amount of accumulated oxygen deficit and the excess of oxygen consumed for its payment. It can be seen that in our case, the oxygen deficit and excess are very close. Only 31.9 % of the achieved Watts are anaerobically provided. According to Cavanagh and Jacobs (1988), however, net VO_2 during the WAnT could account for about 18.5% of the work performed; Serresse et al. (2007) report a 28% share of oxidative processes during the 30-second supramaximal test. They concluded that the 30 s is not strictly anaerobic, although it has a large anaerobic component.

The maximal power output is three times larger than that of CPET. Since the distribution of power data per kg body weight was not normal, comparisons with absolute values were made. We did not find a relationship between the size of the ergometric achievements of the subjects when performing a WAnT and the CPET. There is no correlation between the maximum power reached in the CPET test and the peak, and average power is shown when performing WAnT (correlation coefficient r = .141 and .024, respectively).

In connection with the purpose of our study during the implementation of the WAnT, we registered the cardiorespiratory indicators as those when conducting CPET. Unexpectedly for us, the data obtained in both tests are practically identical (Tables 3 and 5). The differences between the data for most investigated parameters are statistically insignificant. The only exceptions are the heart and the breath frequency and the oxygen heart rate, where the differences in favor of CPET are very small but statistically significant.

Heart rate at the end of CPET exceeds that predicted for individuals of this age and correlates largely with HRmax achieved during WAnT (r=.676). As an indicator of the systolic volume of the heart, the oxygen pulse is at a normal rate. The correlation between the O_2HR in the two maximal tests was r=.650.

The strongest connections between the WAnT and the CPET were found in the ventilator parameters (Table 6). Pulmonary ventilation and respiratory depth during WAnT correlate largely with the most important indicators for aerobic metabolism – VO_2max. Obviously, in the oxygen supply of the muscles at supramaximal load such as the Wingate test, the largest share has the pulmonary ventilation and especially the depth of breathing. To the best of our knowledge, studies comparing the cardiorespiratory response to the VO_2max test and Wingate test have not been carried out.

The identical maximum values of cardiopulmonary parameters achieved in the very different in duration and intensity WAnT and CPET raise the important question of the physiological mechanisms that contribute to this phenomenon.

The control of breathing during exercise is the combined and simultaneous effect of several chemical and neural stimuli. The neurogenic stimuli from the cerebral cortex combined with feedback from the active limbs cause the abrupt increase in ventilation as exercise begins (Mc Ardle et al., 1996).

Analysis of the oxygen transport chain elements from the lungs to the enzymes in the muscle cells when performing the CPET showed a central limitation – the heart's maximal cardiac output. In activities that involve dynamic work with large muscle mass, as in running, it is generally assumed that VO_2max is primarily limited by maximal cardiac output (Mc Ardle et al., 1996). The heart's stroke volume has been thought to be the most important factor, especially since it can be twice as high in trained athletes compared to sedentary individuals (Ferretti, 2014).

Data on high oxygen consumption when performing WAnT by trained cyclists are found by Hawley et al. (1992). They found highly significant relationships between Peak Power (W), VO_2max (r=.97; P<.0001), and 20 km cycle time. They concluded that for trained cyclists, the VO_2max could be accurately predicted from WPeak.

The Wingate test is used as a measure of the anaerobic capacity. However, a significant number of studies show that aerobic metabolism is involved to a large extent in its implementation. Smith and Hill (1991) concluded that glycolytic power peaks within the first 15s of high-power exercise and also, aerobic metabolism responds quickly during „anaerobic" exercise and makes a significant contribution to the work performed. Our measurements showed a significant aerobic energy release even during 30 s exercise (31.9 %). This is in accordance with Medbo and Tabata (1989), determining the accumulated oxygen deficit. The Wingate test does not exhaust the anaerobic capacity and may not be a proper anaerobic capacity test. Wingate test can be as high as 28% of the aerobic contribution for sprinters and 45% for endurance athletes (Stolen et al., 2005).

An explanation for the early activation of aerobics can be found in the studies of Stewart et al. (2011), who follow the changes in muscle fiber conduction velocity when performing WAnT. It is known that at supramaximal loads, fast muscle fibers type II is activated first, which is associated with early and significant lactic acid production (Pernov and Wahren, 1968; Carey and Richardson, 2003; Andreeva et al., 2012). The rice of tissue and blood acidity leads to changes in muscle fiber recruitment and to inhibiting energy production,

hence, limiting work which may contribute to decreasing the acidity and enhancing oxygen supply. Still, the intensity of exercise has to diminish.

CONCLUSIONS

The study confirmed the hypothesis of the existence of relationships between cardiopulmonary parameters obtained during CPET and WAnT. The correlation between WAnT respiratory parameters and oxygen consumption in CPET is most pronounced. The maximal values of cardiopulmonary parameters achieved in the very different in duration and intensity WAnT and CPET are approximately identical. This gives reason to assume that when conducting WAnT with simultaneous registration of respiration, together with the indices of athlete's power output, it could be obtained reliable information about the magnitude of VO_2max and other cardiopulmonary parameters of players. This will greatly facilitate the ongoing control of the exercise conditioning status of athletes.

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Corresponding author:

Borislava Petrova
Center for Scientific and Applied Research in Sport
National Sports Academy "Vassil Levski"
21, Acad. Stephan Mladenov str.
Sofia, Bulgaria
E-mail: bubetokp79@gmail.com

CONTROL TESTS FOR GROWING UP BASKETBALL PLAYERS

Mariana Borukova
National Sports Academy "Vassil Levski", Sofia, Bulgaria

ABSTRACT

The introduction of an updated test battery, covering tests accessible for all age groups and with duration of one training session is needed for the execution of effective control on the growing up basketball players. The purpose of the study was to create an updated test battery for basketball players (boys and girls) of U12, U14, and U16, including three groups of indicators: for physical development, physical preparedness, and technical skills. Three hundred and ten children from the clubs in the country (137 boys and 173 girls) participated in the sport-pedagogical tests. We applied a new test battery, covering 21 indicators, divided into three groups: for physical development, physical preparedness, and technical skills. The results were processed with a variation analysis and comparative analysis by the t-criterion of Student. The results showed statistically important differences for both sexes between U12 and U14 for the physical development and physical preparedness signs and for some tests in relation to the technical preparedness. An important difference was observed between U14 and U16 from both sexes for some of the sings only; as far as the technical skills were concerned, the differences for the boys were due to occasional reasons; for the U16 girls, they were considerably better than the U14 girls. The new test battery objectively reflects the real status of the level of all U12, U14, and U16 competitors. Normative tables will be developed to help the work of the coaches in relation to the optimization of the school-training process.

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ORCID
Mariana Borukova
https://orcid.org/0000-0003-4403-9065

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INTRODUCTION

The complex development of the motive qualities sets up the issue related to the evaluation and control of the specific functional preparation of the growing up competitors. Many researchers developed specific basketball tests and indicators for the purpose (Dasheva, 1991, Zheliazkov and Kelle, 1993). The introduction of puslemetry, the control on La, BE, VO_2max, and other bio-chemical and physiological indicators contributed considerably, in that respect. The evaluation of the young competitors' preparedness degree is often necessary in basketball practice. Thus, the necessary information is received serving as a landmark for their development level – whether they possess the needed physical qualities and basketball skills, whether they are progressing in the school-training process and whether there is a prospect for them to develop as highly-qualified competitors in future (Karalejič and Jakovljevič, 2001).

The first basketball test batteries were related to the specific motive skills. They appeared in the early 1930s and were developed in various periods by D. Brace (1924) and J. Young, K. Moser (1934). During the second half of the century, there were already tests related to the basketball technical skills. A great variety of test batteries, including combinations of various tests are found in the specific basketball literature sources (Temkov, 1956, Semov, 1973, Petrov, 1998, Tzarova, 1981, Zheliazkov et al., 1984, Gyosheva et al., 1990, Pattison, 1990, Karalejič and Jakovljevič, 2001, Tsarova and Tsarov, 2007). Also, three systems for control, evaluation, and optimization of the sports preparation were developed and implement-

ed in practice (Gyosheva et al., 1990). Today many basketball experts use the test battery developed by AAHPERD (American Alliance for Health, Physical Education, Recreation and Dance), covering 4 tests for specific basketball skills: quick shooting for 60 sec.; test for passing on and moving; test for dribble control and test for moving in defense.

The processing of the quantitative information with the help of adequate mathematic-statistic methods and the deep analysis of the data allow for the developing of normative base for control and optimization of the competitive effectiveness of the respective totality. The establishment of such a base is one of the most important conditions for the optimization of sports preparation (Tsarov, 2012).

The scientific and practical experience of basketball experts is exceptionally important for achieving high-effective control. Over our rich experience for setting up sport-pedagogical tests in basketball for coming generations, we have established that the existing test batteries are difficult to apply by coaches as the tests are numerous and require more than one training session. Based on coaches' enquiry information, we have established that the creation of a modern test battery applied within the frames of one training session of 120 min, including tests which are similar for all age groups but differ in relation to the loading and duration, shall optimize the work. Analyzing various test batteries from leading basketball schools such as the Spanish, Russian, American, Serbian, and Australian ones, we have established that additionally to the tests for the physical development and physical preparedness, there should be others similar to the 4 tests presented by AAHPERD. That is why we combined tests from the schools mentioned herein above with total duration time of 120 min. To achieve more effective control, 50 rate normative system will be developed to the test battery while the normative tables shall be presented respectively by sex and age; for girls up to U12, U14 and up to U16 and for boys up to U12, U14, and U16.

The analysis of the facts mentioned above, our personal experience and observations provide us with the reason to admit that for both sexes aged up to 12, up to 14, and up to 16 years there are statistically important differences in relation to some anthropometric characteristics, physical preparedness, and basketball skills. The introduction of a test battery and an actual normative system could facilitate the work of coaches in relation to the optimization of the school-training process.

The purpose of this study was to create an updated test battery for U12, U14, and U16 male and female basketball players covering three groups of indicators: physical development, physical preparedness, and technical skills.

METHODOLOGY

The study was carried out from March 2021 to September 2021.

Participants

The research was done among 310 children – 137 boys and 173 girls, divided into three age groups as follows: U12 – total 117 (45 boys and 71 girls); U14 – total 104 (45 boys and 49 girls) and U16 – total 99 (47 boys and 53 girls).

All participants were male and female basketball competitors – members of various clubs in Bulgaria for the respective age group and taking part in the State Basketball Championship, while some of them were members of the national teams for the respective age. Everybody practices basketball in organized forms and their sports experience depends on their age. The clubs in the country work according to the Unified Teaching Methodology, introduced by the Bulgarian Basketball Federation in 2018.

RESEARCH METHODS AND INDEXES

Procedure

The participants underwent sport-pedagogical testing for the needs of the study and for probating and standardizing the specific test battery. Informed consent and parental permission for all tested participants were obtained for the testing procedure. The study was conducted under the principles stated in the Declaration of Helsinki for human studies and in compliance with the ethical code of the National Sports Academy. Each test was performed twice by the participants and a correlation analysis of both results was made for the needs of the study; the better achievements were processed, and the data were included in the Normative system. Table 1 presents Borukova's test battery (2021). The test battery covers 21 indicators bearing information about the physical development basic signs, the physical preparedness, and the basketball technical skills. The indicators are divided into three groups: for physical development from 1st to 7th indicator; for physical preparedness from 8th to 14th indicator and for technical skills – from 15th to 21st indicator. The tests for physical development and physical preparedness are standard ones used in sports practice for many years already; indicator 13 "Shuttle run" will be described only as it is somewhat different from the one used till now. The technical skills tests are new for the Bulgarian coaches and competitors and for better clearness and perception of the information, they should be described.

Table 1. *Description of Borukova's test battery (2021)*

№	Indexes	Measurement units	Exact. of measurement.	Direction of increase
1.	Height	cm	1,0	+
2.	Weight	kg	0,5	
3.	Body Mass Index	kg/m²	0,01	
4.	Horizontal extension	cm	1,0	+
5.	Vertical extension	cm	1,0	+
6.	Chest measurement - Pause	cm	1,0	+
7.	Chest measurement - respiratory difference	cm	1,0	+
8.	Sprint 20 m	s	0,01	-
9.	Long jump	m	0,01	+
10.	Vertical jump	cm	1,0	+
11.	Maximum Vertical jump	cm	1,0	+
12.	Flexibility	cm	1,0	+
13.	"Shuttle" run (Figure 1)	s	0,01	-
14.	Test for swift-moving along the ground (Figure 2)	s	0,01	-
15.	Dribble and shooting at high speed (Figure 3)	s	0,01	-
16.	Ball keeping index	s	0,01	-
17.	Catching and passing, shooting the basket (Figure 4)	s	0,01	-
18.	Catching, passing, shooting the basket index	s	0,01	-
19.	Shooting – time (Figure 5)	s	0,01	-
20.	Shooting – score	%	0,01	+
21.	Free throw	%	0,01	+

13. 'Shuttle" run – always from baseline to baseline and then to each closer line on the court**.** Short sprints are made by changing the direction along the route, as shown in Figure 1. The participant should step with one foot on the respective line at each change of the direction. Performance time is recorded with exactness of 0.01s. All age groups perform the test the way described in Figure 1.

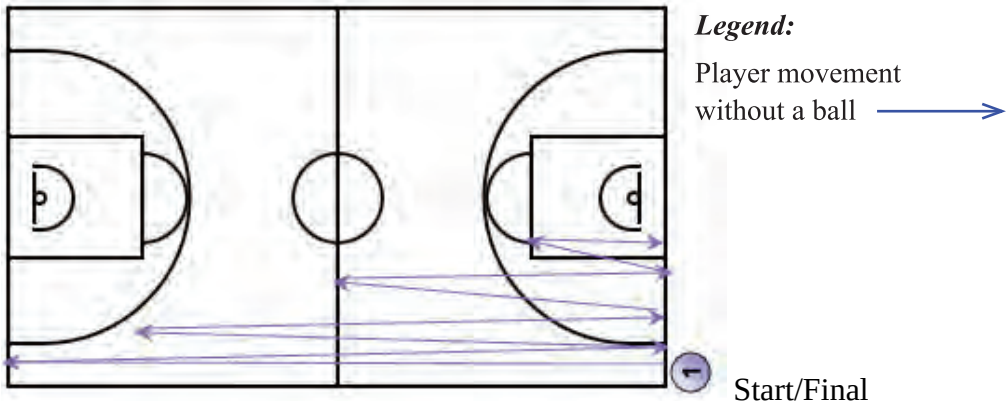

Figure 1. *Shuttle run*

Description of the technical skills tests:

14. Test for swtift-moving along the court without a ball (for agility). From high starting position, with face turned to the center of the court, the competitor moves along the route shown in Figure 2 along the lines of the basketball court: defense moving is fulfilled along the baseline to the paint, sprint - facing the line of the paint, defense moving is again fulfilled along the paint, running backwards along the boundaries of the paint, defense movement is again fulfilled along the baseline. It is performed in both directions – going on and turning back. The direction of moving is by choice – right or left. The result is recorded with exactness of 0.01s.

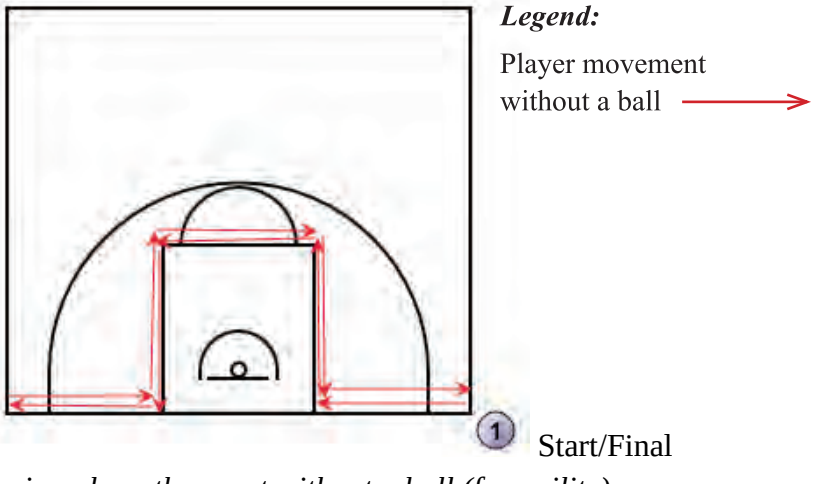

Figure 2. *Test for swift-moving along the court without a ball (for agility)*

15. Dribble, change of direction at high speed, and shooting while moving. The competitor goes along the route shown in Figure 3. He/she performing the exercise stands still at the baseline, next to the cone, at a signal, he/she dribbles with the left hand in the di-

rection of the paint line, passes in front of the cone changing the dribbling hand. Upon each pass in front of the cone, the leading hand is changed. After the last cone, shooting while moving is performed from two-step rhythm finishing with the right hand. Following the shooting, the ball is taken, and the person starts his/her way back in the same way while dribbling with the right hand, upon passing in front of the cones, changes the leading hand, and after the last cone shoots while moving from two-step rhythm, finishing with the left hand. The result is recorded with exactness of up to 0.01s and the number of the baskets scored is counted. For each basket, 1s is taken off, for each ball dropped down or technical mistake, 1s is added.

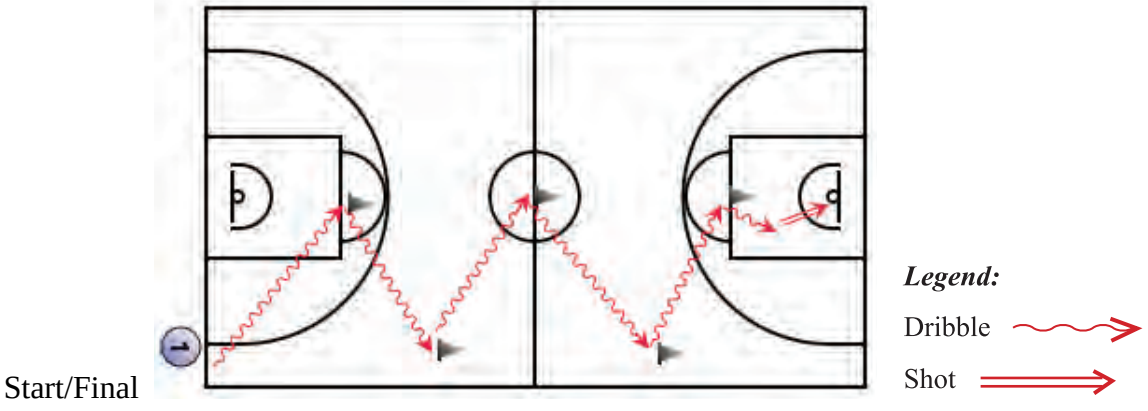

Figure 3. *Dribble, change of direction at high speed, and shooting while moving.*

Equipment: 5 cones, 1 basketball, and a chronometer.

Instructions:

1. For U12

- crossed change of direction is performed;
- 1 tour is passed– going on and coming back (2 shootings -1 with the right hand and 1 with the left hand).

2. For U14

- change of direction with the leading foot;
- 2 tours are passed (4 shootings – 2 with the right and 2 with the left hand).

3. *For U16*

- change direction with a spin move – Rowling;
- 3 tours are passed (6 shootings – 3 with the right and 3 with the left hand).

16. Catching, passing on while moving, and shooting while moving. The competitor executing the test passes along the route shown in Figure 4**.** The person under study stays in front of the board, next to the cone, shoots at the board, jumps up and catches the ball, passes on to X1, runs towards the opposite basket, gets a pass from X1 and passes to X2, runs towards the basket, again receives the ball from X2, passes to X3 and after the free-throw line receives the ball and shoots while moving from two-step rhythm, finishing with the right hand. Following the shooting, the player gets the ball and goes back in the same way, passing on again consecutively to X1, X2, and X3, shooting under the basket with the left hand. The result is recorded with exactness to 0.01s and the baskets made are counted. For each basket scored, 1s is deleted and for each dropped ball or technical mistake, 1s is added.

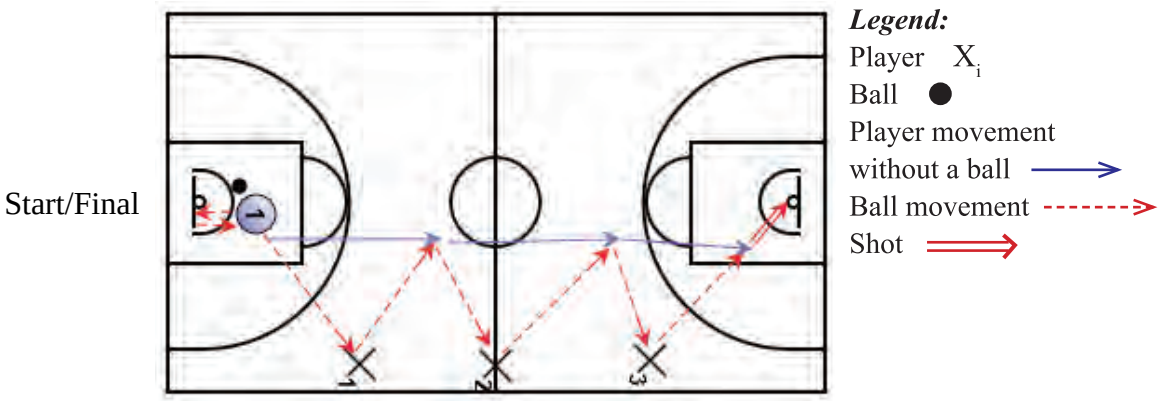

Figure 4. *Catching, passing on while moving, and shooting while moving.*

Equipment: 1 cone, 1 basketball, a chronometer, and 3 feeders**.**

Instructions:

1. For U12

- passing on with two hands;
- 1 tour is passed – going on and coming back (2 shootings – 1 with the right hand and 1 with the left hand).

2. For U14

- passing on with one hand;
- 2 tours are passed (4 shootings – 2 with the right and 2 with the left hand).

3. For U16

- passing on according to the wish of the player;
- 3 tours are passed (6 shootings – 3 with the right and 3 with the left hand).

17. Shooting into the basket for 1 min from 5 positions for 3 points and 5 positions for 2 points – each player shoots independently from the positions, shown in Figure 5 within 1 minute.

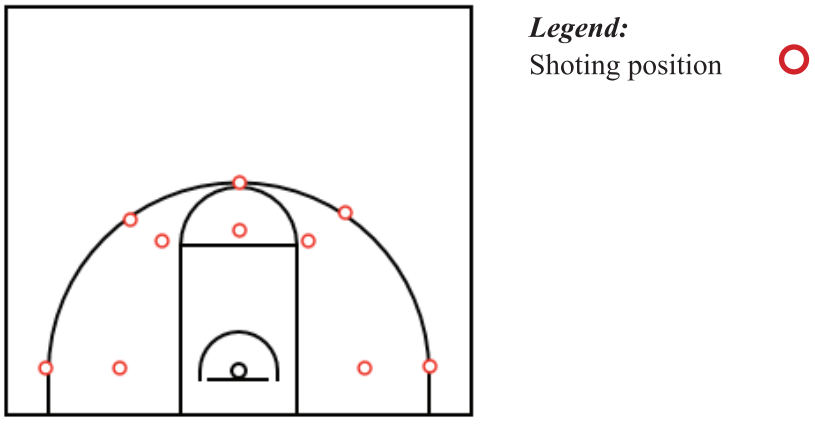

Figure 5. *Shooting into the basket for 1 min from 5 positions for 3 points and 5 positions for 2 points*

Instructions:

1. For U12. The player performs 10 shootings from 5 points shown in Figure 5 (at 3.5 m from the projected center of the ring to the floor) twice from each position. Two series are performed with 1 min rest in between them. The number of the baskets made is recorded.

2. For U14 and U16. The player shoots from each position marked while the first shooting is for 3 points, the second one – inside the three-

point line - for 2 points. The player should go through all positions marked for 1 minute. Performed are 2x10 shootings with 1-minute rest in between both series. The number of the shootings and successful points is recorded.

18. Free throws. Performed in pairs while each one should shoot 5 series of 2 free throws (total 10) with a feeder. The number of the successful free throws is recorded. The relative share (in %) of the successful shots into the basket from the total number of free throws made is recorded as the result from the test.

The sport-pedagogical tests are applied by one and the same researcher or coach of the respective team at terrain conditions within one training session (120 min); second-year students with a major "Basketball coach" at NSA took part in the education process. The anonymity of the children was guaranteed; each one was listed under different number, known to the team coach only. Everybody participated voluntarily in the research and did not receive money or financial compensation for their contribution. None of the participants refused to take part in the study except those who were injured or were not feeling well. Short instructions, video, and demonstration of the test battery were provided prior the tests. The research was carried out in standard conditions – a basketball hall with the necessary equipment: a chronometer, measuring apparatuses, cones, and basketballs. The participants performed the tests twice. The better achievements were recorded for the analysis of the results.

The following research methods were applied for the realization of the purpose and tasks of the study: review study of specific literature and sport-pedagogical testing.

Data analysis

The results of the study were subjected to mathematic-statistical processing with SPSS 23; depending on the tasks of the study, the following statistical methods were applied: *variation analysis, correlation analysis, and comparative analysis by t-criterion of Student at reliability level of Pt ≥ 95%.*

RESULTS

The results from the variation analysis of the physical development indicators under study for the girls and boys showed that the values were normally distributed and the totalities under study were homogeneous and relatively homogeneous in relation to the signs about which these indicators bear information. All three age groups were homogeneous along four signs: height, horizontal and vertical extension, and chest measurement – pause. The latest studies conducted by a scientific team R. Tsarova and M. Borukova during the period 2012/2015 of male and female basketball players from 12 to 16 years of age established that the current competitors from all age groups have much lower results in comparison with the previous generations. The tendency is reduction of the results by each year (Borukova, 2018). Due to the large volume of data, we present only the data of indicators related to physical preparedness of boys and girls (Table 2). The results from the variation analysis for the physical preparedness indicators of the boys and the girls showed that the values had normal distribution too; the totalities under study were homogeneous and relatively homogeneous in relation to the signs under study. The groups of the girls were homogeneous along three signs related to the explosive strength of the lower limbs as regards moving, suppleness, and agility of moving down the court without a ball. Homogeneity and relative homogeneity for various indicators were observed for the separate age groups. Non-homogeneity was observed for "Shuttle run" indicator related to U16 age group (Table 2).

Table 2. *Mean values and dissipation of indicators of physical preparedness*

Age	Indicators	Boys				Girls			
		N	X	S	V	N	X	S	V
12	Sprint 20 m	45	3.87	.273	7.05	71	4	.332	8.3
	Long jump	45	1.76	.188	10.66	71	1.65	.202	12.27
	Vertical jump	45	35.36	7.388	20.9	71	29.41	6.303	21.43
	Maximum vertical jump	45	40.00	9.700	24.38	71	33.00	10.000	29.31
	Flexibility	45	96.82	9.074	9.37	71	100.64	6.703	6.66
	“Shuttle” run	45	34.75	3.38	9.73	71	34.43	3.113	9.04
	Test for swift-moving along the ground	45	19	2.099	11.05	71	19.65	1.865	9.49
14	Sprint 20 m	45	3.53	.254	7.19	49	3.82	.633	16.57
	Long jump	45	2.03	.238	11.73	49	1.76	.164	9.35
	Vertical jump	45	45.19	9.049	20.02	49	32.41	5.377	16.59
	Maximum vertical jump	45	59.00	10.900	18.34	49	38.00	6.600	17.10
	Flexibility	45	101.38	6.29	6.2	49	105.89	7.128	6.73
	“Shuttle” run	45	30.79	2.997	9.74	49	33.76	1.231	3.65
	Test for swift-moving along the ground	45	16.43	1.024	6.23	49	18.06	1.154	6.39
16	Sprint 20 m	47	3.4	.25	7.37	53	3.78	.189	5.01
	Long jump	47	2.28	.243	10.65	53	1.8	.221	12.27
	Vertical jump	47	55.36	8.45	15.26	53	36.78	6.034	16.4
	Maximum vertical jump	47	70.00	9.900	15.50	53	45.00	7.100	15.81
	Flexibility	47	103.36	7.702	7.45	53	109.23	5.714	5.23
	“Shuttle” run	47	30.45	2.486	8.17	53	32.68	1.938	5.93
	Test for swift-moving along the ground	47	15.88	1.278	8.05	53	17.06	.96	5.63

The groups of the boys of all ages were homogeneous along six signs related to the speed abilities, explosive strength of the lower limbs as regards standing and moving, suppleness, speed endurance, and agility while moving down the court without a ball. Relative homogeneity was observed only in relation to the explosive strength of the lower limbs while standing for all three age groups. Boys’ strength develops actively after the puberty while the age groups studied by us are still in the phase of puberty development.

The U12 and U16 girls’ groups were homogeneous along two signs related to the time for the execution of 10 shootings towards the basket as far as the technical preparedness is concerned. Relative homogeneity and non-homogeneity were observed in relation to all the rest of the signs under study for the separate age groups. Unfortunately, that is a bad sign showing that the competitors from the various age groups have difficulties with executing the technique at high speed which is very important for the game.

Strong homogeneity in relation to dribbling the ball and passing on at high speed, as well as the difference “dribble-scored” and the difference “passing on-scored” was observed for the same group of indicators among the U14 boys. The U16 group was homogeneous along one sign only related to the time of executing 10 shootings towards the basket. Relative homogeneity and non-homogeneity were observed in relation to all the other signs for the separate age groups. It can be generalized for the boys as well that it is a bad sign showing that the young U12 male basketball players have difficulties performing the technique at high speed while it is the ability to score baskets for the older groups.

The analysis made so far does not allow for making generalized conclusions. The compar-

ative analysis by *t*-criterion of Student for independent samples at statistical reliability of Pt ≥ 95% was applied for checking up the zero-hypothesis related to the importance of the differences observed between the average levels of the signs under study for the different totalities (U12, U14, and U16 male basketball players as well as U12, U14 and U16 female basketball players). Having in mind the great differences due to the biological development of both sexes, a comparison between U12 and U16 was not applied. A comparison was not made in relation to the "Dribble and shooting at high speed" and "Catching and passing on, shooting towards the basket" indicators; these tests have different requirements for execution and time duration for each age group. Table 3 and Table 4 present the comparative analysis between the average for the U12 and U14 boys ($t_{critical}$ =1,98) and U14 and U16 boys ($t_{critical}$ =1,98).

Table 3. *Importance of the differences for U12 and U14 boys*

Indicators	Age	N	Mean	St	F	t	Sig.
Height	12	45	1.53	.089	1.998	9.514	0
	14	45	1.71	.098			
Weight	12	45	43.24	10.014	5.036	6.584	0
	14	45	59.32	12.971			
BMI	12	45	18.37	2.987	.150	2.553	.012
	14	45	20.02	3.158			
Horizontal extension	12	45	1.52	.100	2.004	9.640	0
	14	45	1.73	.109			
Vertical extension	12	45	1.98	.123	4.408	9.666	0
	14	45	2.27	.154			
Chest measurement - Pause	12	45	73.64	6.898	.140	6.219	0
	14	45	83.13	7.561			
Chest measurement – respiratory difference	12	45	6.94	1.362	4.280	3.702	0
	14	45	8.10	1.590			
Sprint 20m	12	45	3.87	.273	.099	6.139	0
	14	45	3.53	.254			
Long jump	12	45	1.76	.188	4.878	6.002	0
	14	45	2.03	.238			
Vertical jump	12	45	35.36	7.388	5.467	5.647	0
	14	45	45.19	9.049			
Maximum Vertical jump	12	45	39.63	9.660	7.428	8.790	0
	14	45	58.77	10.550			
Flexibility	12	45	96.82	9.074	2.990	2.768	.007
	14	45	101.38	6.290			
"Shuttle" run	12	45	34.75	3.380	.034	5.892	0
	14	45	30.79	2.997			
Swift moving along the ground	12	45	19.00	2.099	16.247	7.387	0
	14	45	16.43	1.024			
Shooting from position – time	12	45	52.26	9.474	.001	5.249	0
	14	45	61.97	8.010			
Shooting for 2 points	12	45	3.36	1.824	3.783	3.542	.001
	14	45	2.18	1.284			
Free throws	12	45	51.78	21.029	.616	3.190	.002
	14	45	65.11	18.540			

Table 3 analysis shows that the calculated values of *t*-criterion were higher than the critical ($t_{critical}$=1.98) one for all indicators. That allows us, with high guaranteed probability, to reject the zero hypothesis and accept as true the alternative hypothesis according to which the differences observed between the average levels of the signs under study for U12 and U14 were statistically significant. That fact was also confirmed by the level of importance α, taking values under .05.

Table 4. *Importance of the differences for U14 and U16 boys*

Indicators	Age	N	Mean	S	F	t	Sig.
Height	14	45	1.71	.098	1.397	4.493	0
	16	47	1.80	.089			
Weight	14	45	59.32	12.971	4.852	3.948	0
	16	47	68.82	9.983			
BMI	14	45	20.02	3.158	1.620	1.904	.06
	16	47	21.19	2.733			
Horizontal extension	14	45	1.73	.109	7.085	4.233	0
	16	47	1.82	.090			
Vertical extension	14	45	2.27	.154	7.895	3.034	.003
	16	47	2.35	.111			
Chest measurement - pause	14	45	83.13	7.561	4.415	4.561	0
	16	47	89.52	5.791			
Chest measurement – respiratory difference	14	45	8.10	1.590	.345	.836	.405
	16	47	8.39	1.769			
Sprint 20 m	14	45	3.53	.254	.425	2.459	.016
	16	47	3.40	.250			
Long jump	14	45	2.03	.238	.071	5.046	0
	16	47	2.28	.243			
Vertical jump	14	45	45.19	9.049	2.177	5.576	0
	16	47	55.36	8.450			
Maximum Vertical jump	14	45	58.77	10.550	3.436	5.070	0
	16	47	70.00	9.900			
Flexibility	14	45	101.38	6.290	.601	1.350	.18
	16	47	103.36	7.702			
“Shuttle” run	14	45	30.79	2.997	.490	.592	.555
	16	47	30.45	2.486			
Swift moving along the ground	14	45	16.43	1.024	3.404	2.269	.026
	16	47	15.88	1.278			
Shooting from position – time	14	45	61.97	8.010	5.566	2.045	.044
	16	47	59.09	5.289			
Shooting for 2 points	14	45	2.18	1.284	.498	.111	.911
	16	47	2.15	1.197			
Shooting for 3 points	14	45	1.36	.981	.810	.928	.356
	16	47	1.55	1.059			
Free throws	14	45	65.11	18.540	.443	3.361	.001
	16	47	51.28	20.811			

Table 4 analysis shows that the calculated values of t-criterion for some indicators were higher than the critical ($t_{critical}$=1.98) one. That allowed us, with high guaranteed probability, to reject the zero hypothesis and accept as true the alternative hypothesis according to which the differences observed between the average levels of the signs under study for U14 and U16 were statistically significant. However, the indicators whose empirical values were lower than the critical, showed that the differences were not statistically significant and may be explained by occasional reasons. These are signs bearing information about the obesity degree, chest development degree, suppleness, speed endurance, as well as the ability to score baskets while shooting from position for 2 and 3 points by the young competitors.

Table 5 presents comparative analysis of the average for the U12 and U14 girls. When analyzing the table, we can see that for a greater part of the sings under study, higher values of t-criterion were observed, while for four of the signs, they were lower than the critical ($t_{critical}$=1.98) one, which shows that the existing differences were not statistically significant and may be explained by occasional reasons. These are signs related to horizontal and vertical extension, speed endurance, and the ability to score free throws.

Table 5. *Importance of differences for U12 and U14 girls*

Indicators	Age	N	Mean	S	F	t	Sig.
Height	12	71	1.56	.079	4.321	7.746	0
	14	49	1.66	.062			
Weight	12	71	45.14	10.306	.105	7.243	0
	14	49	59.62	11.398			
BMI	12	71	18.02	4.497	.771	4.646	0
	14	49	21.46	3.123			
Horizontal extension	12	71	1.55	.083	5.943	1.056	.293
	14	49	1.66	.064			
Vertical extension	12	71	2.02	.103	5.951	1.242	.217
	14	49	2.14	.082			
Chest measurement - pause	12	71	78.23	7.689	2.647	5.96	0
	14	49	86.18	6.369			
Chest measurement – respiratory difference	12	71	6.46	1.468	1.873	3.643	0
	14	49	7.38	1.184			
Sprint 20m	12	71	4.00	.332	.009	1.984	.05
	14	49	3.82	.633			
Long jump	12	71	1.65	.202	2.719	3.078	.003
	14	49	1.76	.164			
Vertical jump	12	71	29.41	6.303	.409	2.717	.008
	14	49	32.41	5.377			
Maximum Vertical jump	12	71	33.00	10.000	.662	3.520	.001
	14	49	38.00	6.600			
Flexibility	12	71	100.64	6.703	1.32	4.107	0
	14	49	105.89	7.128			
“Shuttle” run	12	71	34.43	3.113	.554	1.648	.077
	14	49	33.76	1.231			
Swift moving along the ground	12	71	19.65	1.865	8.008	5.323	0
	14	49	18.06	1.154			

Shooting from position - time	12	71	53.02	5.146	12.067	2.609	.01
	14	49	43.69	9.542			
Shooting for 2 points	12	71	2.92	2.034	17.681	5.67	0
	14	49	1.10	1.123			
Free throws	12	71	4.48	1.731	.780	1.301	.196
	14	49	3.91	2.780			

Table 6 presents comparative analysis of the average for U14 and U16 girls.

Table 6. *Importance of the differences for U14 and U16 girls*

Indicators	Age	N	Mean	S	F	t	Sig.
Height	14	49	1.66	.062	1.763	1.441	.153
	16	53	1.68	.068			
Weight	14	49	59.62	11.39	1.172	1.572	.119
	16	53	62.82	9.129			
BMI	14	49	21.46	3.122	.035	1.280	.204
	16	53	22.26	3.142			
Horizontal extension	14	49	1.66	.064	4.43	0.871	.386
	16	53	1.68	.072			
Vertical extension	14	49	2.14	.082	4.434	1.036	.303
	16	53	2.16	.092			
Chest measurement - pause	14	49	86.18	6.369	.462	1.436	.154
	16	53	87.86	5.396			
Chest measurement – respiratory difference	14	49	7.38	1.183	.011	0.583	.561
	16	53	7.52	1.259			
Sprint 20m	14	49	3.82	0.633	1.999	0.503	.616
	16	53	3.78	0.188			
Long jump	14	49	1.76	0.164	2.369	1.175	.243
	16	53	1.80	0.221			
Vertical jump	14	49	32.41	5.377	1.102	3.851	0
	16	53	36.78	6.033			
Maximum Vertical jump	14	49	38.00	6.600	1.507	4.820	0
	16	53	45.00	7.100			
Flexibility	14	49	105.89	7.127	3.114	2.619	.01
	16	53	109.23	5.713			
“Shuttle” run	14	49	33.76	1.231	1.538	3.300	.013
	16	53	32.68	1.938			
Swift moving along the ground	14	49	18.06	1.153	1.225	4.745	0
	16	53	17.06	.960			
Shooting from position - time	14	49	43.69	29.542	15.001	2.254	.026
	16	53	55.54	23.380			
Shooting for 2 points	14	49	1.10	1.122	.249	2.915	.004
	16	53	1.8062	1.3015			
Shooting for 3 points	14	49	.7551	.8787	1.931	2.406	.018
	16	53	1.2326	1.1028			
Free throws	14	49	39.1837	29.77952	6.632	2.05	.038
	16	53	50.566	24.76156			

Differing from the boys, statistically significant differences were not observed along nine signs for the girls because of the values of $t \leq 1.98$. These are signs related to the physical development, speed abilities, and explosive strength of the lower limbs in horizontal plain. Differences were observed only in relation to some signs of the physical preparedness and for all technical skill indicators. That shows that in relation to the selection of U16 girls, there were some omissions, but on the account of that, the level of the technical preparedness was statistically important in comparison with U14.

DISCUSSION

Modern basketball development sets up high requirements to coaches and young competitors. Different and varied test batteries exist for control on the sports preparedness of the growing-up basketball players. The Bulgarian Basketball Federation has not set up a requirement for obligatory tests, so their application depends on coaches' wish to control and optimize the school-training process. Well known and established test batteries according to Tsarov (2008), Gyosheva et all (1990), and Tsarova (1990) have been predominantly used in Bulgaria in the last years; however, their results cannot be analyzed and compared with the achievements of the up-to-date competitors; coaches do not have much time, needed for the correct conducting of these tests (2 training sessions are required). The last research of a scientific team of R. Tsarova and M. Borukova was done during the period 2012/2015 on young male and female basketball players from 12 to 19 years of age; the authors established that the competitors of today have lower results as compared to the earlier generations. It is a tendency for the results to be reduced by each coming year which imposes the creation of a new test battery and an actual normative system for it. There are various methods for developing norms. Our rich experience in that direction shows that for the sports games (particularly basketball), the use of Sigma method is fully justified (Tsarov, 2012). Normative tables can be developed in various point systems. The 50-rate point system is the most suitable for highly qualified basketball players. It allows recording even the smallest change (in positive or negative direction) of the development level of each of the signs under study (Tsarov, 2013).

CONCLUSION

The analysis of the data provides us with the reason to consider that the test battery proposed by us fully answers the requirements for control on growing-up basketball players. After an analysis and discussions of the results with the coaches of the participants, it was established that they objectively present the real level status of the male and female young basketball players at the various age groups. Up to now, all coaches of the teams which took part in the sport-pedagogical study with Borukova's (2021) new test battery think that it covers exhaustive information in relation to the physical development, physical preparation, and competitors' technical skills level. They like the fact that the tests are conducted within one training session only, which makes it easier for them; they wish to go on with current and phase tests during the present season. The use of Sigma method allows for the development of normative tables by which the status of each sign (indicator) under study can be easily evaluated. That would help the work of coaches to optimize the school-training process.

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Corresponding author:

Mariana Borukova
Department „Basketball, Volleyball, Handball"
National Sports Academy „Vassil Levski"
21, Acad. Stefan Mladenov Str.
Sofia 1700, Bulgaria
E-mail: marianaborukova@gmail.com

INDIVIDUALISM, COLLECTIVISM, AND GOAL ORIENTATION FOR ATHLETES FROM INDIVIDUAL AND TEAM SPORTS

Polina Hadjiyankova, Tatiana Iancheva
National Sports Academy "Vassil Levski", Sofia, Bulgaria

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ORCID
Tatiana Iancheva
https://orcid.org/0000-0001-9718-6056
Polina Hadjiyankova
https://orcid.org/0000-0002-3291-5323

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ABSTRACT

In the last years, the issue concerning individualism and collectivism in sport has increasingly attracted researchers' attention. The relation between individualism-collectivism and performance has been surveyed (Cox et al., 1991, Mann, 1980, Wagner, 1995), the stability of teamwork (Kiffin-Petersen & Cordey, 2003, Kirkman, 1996, Kirkman & Shapiro, 2001), team performance (Karsh, 1984, Smith, 1984).

This study aimed to examine individualism and collectivism and their relation to goal orientation among athletes with different levels of qualification practicing six different kinds of sport. The research was done among 160 athletes practicing six sports – three (3) team sports and three (3) individual sports.

To fulfill the aim of the research, we used: 1. Scale for measuring the horizontal and vertical individualism and collectivism INDCOL of Singelis, Triandism Bhawuk, & Gelfand, 1995; 2. Task and Ego Orientation in Sport Questionnaire – TEOSQ, Duda & Nicholls, adapted for Bulgarian conditions by Domuschieva-Rogleva, 2003. 3. Psychological Collectivism Measure – Jackson et al., 2006.

We established significant differences among competitors practicing individual and team sports and differences depending on the qualification, club affiliation, gender. The influence of individualism and collectivism on goal orientation in sport was revealed.

Keywords: *Individualism, Collectivism, Goal orientation, Ego-orientation, Task-orientation*

INTRODUCTION

In the last twenty years, individualism and collectivism have attracted social scientists' attention – sociologists, anthropologists, and psychologists. Psychologists' great interest has been enhanced due to'Hofstede's research (2011). He explained the intercultural differences with four empirically determining dimensions, one of which was individualism-collectivism. Hofstede pointed out that this dimension is a sociological one, i.e., it explains the peculiarities of the different social environments and the restrictions posed by them on individuals' development. It is not a psychological construct, i.e., it does not serve for comparison and explanation of the behavior of different personalities.

Although the constructs individualism and collectivism are often viewed in literature as the features of different nationalities and cultures, they have also been analyzed as variables on individual-level accounting for the differences among the people belonging to the same nation and culture (Dolan et al., 2004, Eby & Dobbins, 1997, Kozan & Ergin, 1999, Schwartz, 1992, Sinha & Tripathi, 1994, Triandis, 1998, 1989, 1995, Wagner, 1995, Wagner & Moch 1986). Some authors (Oyserman et al., 2002,

Triandis, 1995) believe that the construct is made of two semi-independent dimensions. According to them, individualism and collectivism exist as two different dimensions. It is quite possible for a specific athlete to possess both high individualism and high collectivism, i.e., the characteristics do not exclude one another. This debate has led to various research theses and empirical research in this sphere.

The individual differences along the axis of individualism-collectivism are based on self-concept. Although self-concept is made of numerous identities based on communication with different groups (Stryker, 1980), individualists generally perceive themselves as egocentric and independent. Individualists define themselves as people standing out in the team and view their performance as a result of their individual efforts (Hofstede, 1980, 1991, Triandis, 1980, 1989, 1990). Thus, individualists can be highly motivated by competition, individual rewards, and recognition. They can often work and invest additional efforts to achieve their individual goals (Stone, Romero & Stone, 2002).

A personality is perceived as an autonomous, independent subject who is self-dependent and different from other people, teams, and subjects. As a result, egocentrics strive to be as independent, autonomous, and self-dependent as possible. They do not have solid bonds with others and feel different from the other team members. In contrast to individualists, collectivists will feel embarrassed if they receive individual recognition. They prefer cooperating to competing, merging with the group to standing out with their personal manifestation.

The research on the relation between individualism-collectivism and performance shows that individualists are a little more cooperative than collectivists in group and team activities (Cox et al., 1991, Mann, 1980, Wagner, 1995).

Some researchers point out that individualism is related to the stability of teamwork (Kiffin-Petersen & Cordey, 2003, Kirkman, 1996, Kirkman & Shapiro, 2001). Earley (1998) pointed out that collectivists perform better when they share responsibilities, unlike when they are given individual tasks.

Kirkman et al. (2001) presented a comparison between individualists and collectivists. He revealed that individualists are more stable when working in a team and are less susceptible to the idea that the things they receive are based on team performance. In addition, Gibson and Zellmer-Bruhn (2001) established that individualism limited the range of teamwork expected by the team. On the other hand, due to the importance collectivists attach to shared responsibility, the researchers pointed out that collectivism should help team performance (Karsh, 1984, Smith, 1984).

Wagner (1995) views "individualism-collectivism" as an analytical dimension reflecting the relative importance people attach to personal interests and shared goals. Individualists attach more meaning and importance to their personal goals than to the team's needs. They take care of themselves and ignore the team's interests when contrasted with their personal interests. According to this perception, collectivism is the opposite of individualism (Hui, 1998, Oyserman et al., 2002).

In a broad sense, in sport, collectivism presents the border to which different individuals are oriented in their group (team) goals. Such individuals are concerned for the well-being of

their teammates, accept group norms, and tend to cooperate in the group (team) (Triandis, 1995, Wagner, 1995, Wagner & Moch, 1986).

Because of these reasons, collectivism is viewed as a logical research construct due to its influence on teams' functionality. The surveys show that in teams consisting of persons with a high level of collectivism, competitors give each other more emotional, informative, and sustaining support compared to other teams consisting of athletes with a low level of collectivism (Drack-Zahavy, 2004).

The ratio among the players with high and low levels of collectivism on a team is directly related to the cooperation in the team (Eby & Dobbins, 1997).

Jackson (Jackson et al., 2006) described five specific aspects of collectivism: Preference, Concern, Hope, Acceptance of norms, Prioritization of goals.

Collectivists view team interests as more important than individual needs and desires. They tend to take care of the well-being of the team they belong to even when such actions lead to sacrificing their personal interests (Wagner & Moch, 1986).

For the aims of this research, we focused on the variable individualism-collectivism on an individual level, which perceives individualism and collectivism as opposite characteristics. The surveys of Ramamoorthy and Flood (2002, 2004) revealed that whether one is an individualist or a collectivist is determined by one's preferences for individual work, personal goals, competitiveness, and autonomy.

Individualism and collectivism are constructs we can trace both in individual and team sports. We can assume that athletes with more expressed collectivism and more weakly expressed individualism can be found more often in team sports. However, whether this is so or not, does it mean that when people practice a team sport, they are more collectivist than individualists and vice versa?

A sports team is a union of athletes who have both personal and shared tasks to achieve a mutual sports result. The common goal and the everyday tasks turn a sports team into a collective subject of sports activity.

The sports environment stimulates the process of self-identification both on an individual and on a group level. Identity stirs security, stability of behavior, and the ability for integrity.

The scientific information on the issue of individualism and collectivism in sport in the literature we know about is still scarce. Few authors have viewed this issue theoretically and empirically, and even fewer are willing to engage themselves with a particular stable concept.

We are interested in the relation among the constructs of individualism and collectivism and goal orientation in sport. According to the theory of goal orientation in sport (Duda, 1989), when there is a high task orientation, success is determined as a result of improvement in skills, self-perfection, positive and adaptive behavior aimed at achievements. Ego orientation is related to behavior aimed at domineering, superiority or obedience, comparing one's own abilities with those of the others. Nicholls's goal theory of achievement (1984, 1989) supposes that achieving the goal and demonstrating abilities are significant motivation incentives in the context of achievements. The representatives of this theory have outlined two concepts for

competence which are manifested through the two conditions – task purpose or ego purpose. When the participation is because of the task, the perceived ability is related to itself. The emphasis is on mastery, effort investment, development of skills, or gaining knowledge about the activity. When ego dominates, persons show a high ability compared to the norms. In this case, the ability is demonstrated when one's performance surpasses that of the others or is done equally well but with fewer efforts (Nicholls, 1984, 1989).

This study aimed to examine individualism and collectivism and their relation to goal orientation among athletes with different levels of qualification practicing six different kinds of sports.

MATERIALS AND METHODS

Participants

The research was done among 160 athletes from six different sports – 3 team sports (football, basketball, volleyball) and 3 individual sports (tennis, swimming, rowing), from 8 clubs and 1 national team. Of them, 110 men and 50 women aged between 16 and 35 years. For the research purpose, the competitors were divided into two groups depending on their qualification – athletes competing for the national team and athletes belonging to a club.

At the beginning of the research, all participants were informed about the survey's aim, and their consent was obtained.

We assume that there are certain differences regarding individualism and collectivism among athletes practicing individual and team sports and differences depending on their level of qualification. We suppose there are specific differences in the goal orientation of players with a dominant individualism or collectivism.

Instruments

To fulfill the aim of the research, we used complex methods including:

Scale for measuring the horizontal and vertical individualism and collectivism INDCOL of Singelis, Triandism Bhawuk, & Gelfand, 1995. The scale consists of four subscales:

- Horizontal individualism (HI) – the desire to be unique, to stand out in a group, to rely only on yourself;
- Vertical individualism (VI) – the desire to be different and recognizable due to your personal merits and wins;
- Horizontal collectivism (HC) – the desire to be uniform with others, to belong to and depend on the group;
- Vertical collectivism (VC) – the desire for affiliation and mutual success in the group but attaching a tremendous significance to the family and its expectations.

The vertical scale emphasizes the hierarchy while the horizontal one emphasizes equality in relationships.

Task and Ego Orientation in Sport Questionnaire – TEOSQ, Duda & Nicholls, 1992 (Castillo et al., n.d.), adapted for Bulgarian conditions by Domuschieva-Rogleva, 2003. The test consists of 13 items and a 5-point Likert-type scale to evaluate the degree of their expressiveness. It measures the factors task orientation and ego orientation.

Psychological Collectivism Measure – Jackson et. al., 2006. The scale consists of 15 items, assessed with a 5-point Likert type scale. It mea-

sures the degree of collectivism inside a team.

The scales show very good psychometric characteristics in Bulgarian conditions.

Statistical Analysis

When processing the initial data from the research, we used the statistical package SPSS 21 and made a variation, correlation, comparative, and regression analyses.

All participants were informed about the research aim and granted their agreement.

The research was held in the period March-July in actual conditions.

RESULTS AND ANALYSIS

The obtained results revealed that horizontal collectivism's scale received the highest values (M = 3.94). It reflects the strong desire for affiliation to the group and mutual dependence (Table 1). Next was the scale horizontal individualism (M = 3.87), related to the desire to be unique, stand out in the group, and rely on yourself. We were rather impressed by the low values of the vertical scales – vertical collectivism (M =3.34) and vertical individualism (M = 3.31), i.e., the scales related to hierarchy.

We were surprised by the obtained results related to the research of goal orientation. The results from this survey showed that ego orientation was the leading one (M = 3.61). The mean value for the task orientation was M = 3.43. These results differ from those obtained in other surveys of ours (Iancheva, Kuleva, 2017; Iancheva, 2019) and some data in the literature.

Table 1. *Results from descriptive statistics*

	N	M	SD	Min	Max	Variance
Horizontal individualism	160	3.8663	.65172	1.10	5.00	.425
Vertical individualism	160	3.3106	.64160	1.00	4.70	.412
Horizontal collectivism	160	3.9438	.70405	1.00	5.00	.496
Vertical collectivism	160	3.3350	.62215	1.00	4.70	.387
Collectivism	160	3.6881	.78743	.60	5.00	.620
Task Orientation	160	3.4319	.72306	1.00	5.70	.523
Ego Orientation	160	3.6106	.59427	1.00	5.00	.353
Age	160	18.4688	4.56941	16.00	35.00	20.880

The data from the comparative analysis of the results of the athletes practicing individual and team sports revealed statistically significant differences along three of the researched parameters (Table 2) – horizontal collectivism, degree of collectivism in the team, and task orientation. Our expectations were confirmed – the representatives of the team sports possessed significantly higher collectivist attitudes. The athletes practicing individual sports were characterized with a more strongly expressed task orientation, i.e., mastery through investing efforts and development of skills and knowledge.

Table 2. *Results from the comparative analysis of athletes practicing individual and team sports*

	HI	VI	HC	VC	COLL	TASK	EGO
Mann-Whitney U	2506.000	2903.000	1538.000	2681.000	1859.500	2277.500	2480.500
Wilcoxon W	7556.000	4733.000	3368.000	4511.000	3689.500	7327.500	7530.500
Z	-1.744	-.344	-5.163	-1.132	-4.025	-2.550	-1.838
Asymp. Sig. (2-tailed)	.081	.731	.000	.258	.000	.011	.066

Legend: *HI - Horizontal individualism, VI - Vertical individualism, HC - Horizontal collectivism, VC - Vertical collectivism, Collectivism, Task Orientation, Ego Orientation*

The obtained results revealed significant differences along the factor gender and three of the researched indicators – horizontal and vertical collectivism and degree of collectivism in the team (Table 3). We established significantly higher values along the three subscales among the men, i.e., a greater aspiration for affiliation and success in the team, mutual dependence on the group.

Table 3. *Results from the comparative analysis along with the factor gender*

	HI	VI	HC	VC	COLL	TASK	EGO
Mann-Whitney U	2440.000	2349.000	1493.000	2050.500	1710.500	2682.500	2411.000
Wilcoxon W	3766.000	3675.000	2819.000	3376.500	3036.500	4008.500	8406.000
Z	-1.245	-1.585	-4.720	-2.687	-3.919	-.356	-1.354
Asymp. Sig. (2-tailed)	.213	.113	.000	.007	.000	.722	.176

The results from the comparative analysis depending on club affiliation were quite interesting. The data revealed significant differences along all scales measuring individualism and collectivism (Table 4). The specific sports environment and the management style probably influence the researched indicators.

Table 4. *Results from the comparative analysis depending on the club affiliation*

	HI	VI	HC	VC	COLL	TASK
Chi-Square	13.223					
df	5	5	5	5	5	5
Asymp. Sig.	.021	.021	.007	.004	.001	.120

Legend: *HI - Horizontal individualism, VI - Vertical individualism, HC - Horizontal collectivism, VC - Vertical collectivism, Collectivism, Task Orientation, Ego Orientation*

The comparative analysis of the data results showed dependence on the qualification. The athletes competing for the national teams had higher values of vertical individualism (VI), characterized by the desire to be different and recognizable due to personal merits and wins and a lower degree of collectivism in the team (Table 5).

Table 5. *Results from the comparative analysis depending on qualification*

	HI	VI	HC	VC	COLL	TASK	EGO
Mann-Whitney U	2120.500	1541.500	1979.500	1962.500	1759.500	1981.500	1853.500
Wilcoxon W	9870.500	9291.500	2645.500	2628.500	2425.500	2647.500	9603.500
Z	-.456	-2.836	-1.034	-1.108	-1.933	-1.025	-1.552
Asymp. Sig. (2-tailed)	.648	.005	.301	.268	.043	.305	.121

Legend: *HI - Horizontal individualism, VI - Vertical individualism, HC - Horizontal collectivism, VC - Vertical collectivism, Collectivism, Task Orientation, Ego Orientation*

Table 6. *Results from the comparative analysis depending on the qualification of the athletes practicing team sports*

	HI	VI	HC	VC	COLL	TASK	EGO
Mann-Whitney U	2120.500	1541.500	1979.500	1962.500	1759.500	1981.500	1853.500
Wilcoxon W	9870.500	9291.500	2645.500	2628.500	2425.500	2647.500	9603.500
Z	-.456	-2.836	-1.034	-1.108	-1.933	-1.025	-1.552
Asymp. Sig. (2-tailed)	.648	.005	.301	.268	.043	.305	.121

Legend: *HI - Horizontal individualism, VI - Vertical individualism, HC - Horizontal collectivism, VC - Vertical collectivism, Collectivism, Task Orientation, Ego Orientation*

The group of the athletes practicing individual sports had significant differences in the degree of collectivism in the team (Table 7). The athletes with a higher level of qualification had significantly more weakly expressed collectivist attitudes.

Table 7. *Results from the comparative analysis depending on the qualification of the athletes practicing individual sports*

	HI	VI	HC	VC	COLL	TASK	EGO
Mann-Whitney U	240.000	259.000	253.000	233.500	110.000	248.000	188.000
Wilcoxon W	1465.000	1484.000	319.000	299.500	176.000	1473.000	1413.000
Z	-.565	-.201	-.316	-.691	-3.054	-.411	-1.562
Asymp. Sig. (2-tailed)	.572	.840	.752	.490	.002	.681	.118

Legend: *HI - Horizontal individualism, VI - Vertical individualism, HC - Horizontal collectivism, VC - Vertical collectivism, Collectivism, Task Orientation, Ego Orientation*

Table 8. *Results from regression analysis*

	β	t	Sig	ΔR^2
Horizontal individualism				
Ego orientation	.336	4.653	.000	.161
Vertical individualism	.272	3.778	.000	.231
Vertical individualism				

Horizontal individualism	.314	4.365	.000	.125
Vertical individualism	.284	3.950	.000	.204
Horizontal collectivism				
Collectivism	.531	8.03	.000	.408
Vertical collectivism	.223	3.263	.001	.462
Task orientation	.129	2.137	.034	.477
Vertical collectivism				
Horizontal collectivism	.261	3.016	.003	.255
Vertical individualism	.186	2.747	.007	.302
Collectivism	.269	3.178	.002	.337
Task orientation	.147	2.168	.032	.357
Collectivism				
Horizontal collectivism	.552	8.038	.000	.408
Vertical collectivism	.228	3.287	.001	.438
Task orientation	-.143	-2.330	.021	.457

DISCUSSION

The results from the research we carried out confirmed our initial hypothesis that there are certain differences regarding individualism and collectivism among athletes practicing individual and team sports, as well as differences depending on the level of qualification. The data obtained from the athletes practicing individual and team sports revealed statistically significant differences along three of the researched indicators – horizontal collectivism, degree of collectivism in the team, and task orientation. Our expectations that the athletes practicing team sports have significantly higher collectivist attitudes were confirmed. The athletes practicing individual sports are characterized with a more strongly expressed task orientation, i.e., mastery and achieving results through investing efforts, developing skills, and gaining knowledge.

The results from the comparative analysis of the data depending on qualification did not fully confirm our initial expectations. The athletes who compete for the national teams showed significantly higher values along the vertical individualism scale. They had a higher aspiration to be different and recognizable because of their own achievements and merits. After the additional analyses made for each group – individual and team sports, we found that the competitors practicing individual sports, with higher levels of qualification, had significantly more weakly expressed collectivist attitudes. These results were to be expected and confirmed the data found in literature (Hofstede, 1980, 1991, Triandis, 1980, 1989, 1990). The athletes with a higher level of qualification, practicing team sports, had significantly higher values of vertical individualism. They seek recognition and want to stand out on the basis of their efforts and the achieved level of development, i.e., we can assume that the more successful competitors, whether they are representatives of individual or team sports, possess a more strongly expressed individualism.

There were significant differences along all scales of individualism and collectivism depending on club affiliation. The specific sports environment and the coach's management style probably influenced the researched indicators. These results will require further research and analyses.

There were significant gender differences along all scales of collectivism. Men have a more strongly expressed aspiration for affiliation, dependence, and success on the team, regardless of the kind of sport they practice.

We found the results from the research of goal orientation surprising. Ego orientation was dominant in our sample, which differs from the findings in our previous studies (Iancheva, Kuleva, 2017, Iancheva, 2019).

The obtained results from the regression analysis regarding the relation among individualism, collectivism, and goal orientation in sports, make us assume that individualism and collectivism affect goal orientation in sports. Horizontal individualism stimulates ego orientation. Horizontal and vertical collectivism can forecast task orientation, the degree of collectivism in the team, and can stimulate task orientation.

LIMITATIONS

This research has a few limitations – the number of the researched sample and the number of the researched sports. A broader scope of research would allow for more in-depth analysis and interpretation.

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Corresponding author:

Tatiana Iancheva
Psychology, Pedagogy, Sociology Department
National Sports Academy "Vassil Levski"
21, Acad. Stefan Mladenov, str.
Sofia, Bulgaria
E-mail: iancheva.tatiana@gmail.com

PROFILE OF THE ORGANIZATIONAL CULTURE IN YOUTH CLUB FOOTBALL (THE PRESENT SITUATION IN BLAGOEVGRAD REGION)

Trayan Popkochev, Valeri Tsvetkov
South-West University "Neofit Rilski," Blagoevgrad, Bulgaria

ABSTRACT

The end of the crisis in Bulgarian football is discussed through the perspective of solving the problems in youth football. Although organizational culture is essential for effectiveness within organizations, few studies are related to the organizational culture in (youth) football clubs in Bulgaria.

The article aims at studying the organizational culture in three clubs from the Youth-17 League in the South-West Bulgaria Zone 1 and Zone 2.

60 players and 3 coaches participated in a survey conducted through OCAI (Cameron and Quinn). The weight of certain factors considered important for achievement in clubs was measured through dispersion analysis.

The hierarchy and clan types are predominant in the club's profiles. According to the analysis, the present state is characterized by fewer distractions than the desired state. ANOVA shows that the team success factor has the strongest influence regarding the differentiation of the clan (present state) and market (desired state) types of cultures. The competing experience factor has a lesser effect and differentiates the market and the adhocracy type of cultures (the desired state). The prospect factor differentiates between the clan and market type in the desired state.

Both groups surveyed have similar preferences for the types of organizational culture in the teams, with the "strength" of the preference criteria having higher value with the coaches.

The typical team sport profile of organizational culture is observed. Coaches can influence the sports training activities and manage the organizational culture in the clubs through the factors mentioned above when players are still young.

The study is not representative of the South-West League and Bulgaria as a whole.

Organizational culture significantly influences competing efficiency and good youth football players' making.

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ORCID
Trayan Popkochev
https://orcid.org/0000-0003-2789-2566
Valeri Tsvetkov
https://orcid.org/0000-0003-4932-4885

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INTRODUCTION

Bulgarian men's football has been in a state of ongoing crisis since the successful performance at the 1994 World Cup (BFU; Balakov, 2020; Kartunov, 2020). The lack of continuity in athlete creation is a major underlying cause of the crisis, which football players, coaches, sports leaders, and professional football club owners constantly discuss. (BFU). There is strong criticism of the ineffective recruitment policies in youth football and the development of elite professional players. (Ilchev, 2019). Crucial areas often discussed are discipline, sporting honour, responsibility to the team, players' motivation, discipline, and self-discipline (Christo Stoichkov spoke strongly about it), relationships within the team: between players, players, and coaches, dedication, etc.

Such issues are directly related to building an organizational culture. In Bulgaria, it is a

problem that in the management documentation (Natsionalna strategia, 2011; Natsionalna programa, 2020) and many statements of football coaches and managers on organizational culture in football, its study and management is neglected, even though it has an important practical significance.

In terms of scientific research, the topic of organizational culture in sport (Slack, Parent, 2006; Girginov, 2010; Cruickshank, Collins, 2012; Wagstaff, Wylie, 2018; Maitland, Hills, Rhind, 2015) has already received serious attention in some sports (Champ et al., 2020), however, in Bulgaria it is explored neither in youth nor in professional football.

SPORTS AND ORGANIZATIONAL CULTURE

In the second half of the 20th century, a significant integration process began between sports and sports science, on the one hand, and other scientific fields, on the other. Thus, nowadays, it is impossible to build and manage an elite sports club without researching several integrative scientific areas, such as sports medicine, sports psychology, sports sociology, sports marketing, sports management (Bill, 2009, Wagstaff, Burton-Wylie, 2018), and *organizational culture.* A well-established practice exists in publications of didactic nature for organizational culture in sports to be considered in the context of sports management (Hoye et al. l, 2009). Organizational culture brings together knowledge in the fields of sports management and organization theory, sports psychology, and sports sociology, culturology. (Slack, Parent, 2006, Bill, 2009, Hoye, et al., 2009, Girginov, 2010). Organizational culture and management share a fundamental function that has both individual and social dimensions: "both strive to create order and to avoid uncertainty" (Girginov, 2010).

Despite the differences in the understanding of organizational culture as something that organizations *are* and something that, amongst other things, *characterizes* them, the content of the notion includes:

- "symbols, heroes, rituals, and values" shared and validated into practice (Hofstede, 2010), which function as "mental programs or…software of the mind" in organizations, ideals, and basic self-evident collective notions which influence problem-solving in a dynamic environment when adaptation to change and inner integration is required (Shain, 2002);
- Essential values (such as respect, quality, discipline, ethics, dedication, honor, justice/impartiality), beliefs, and attitudes which shape the behavior within the organization, thus turning into standards and norms of behavior in the organization (Hoye et al., 2009).

Organizational culture works to preserve the homeostasis of an organization and protect it from the impact and threats of the external environment. It influences the integration of organization members and the creating of organizational identity. Organizational culture helps regulate the behavior of organization members and the integration of newly enrolled ones. It influences goals, motivation, and results both on an individual and team level and plays a vital role in the stability, adaptability, and innovation within an organization. Its condition and functionality can be used as signals for necessary changes in the values and structure of an organization.

Girginov noted that organizational culture strongly influenced the way sports management was studied, taught, and practiced (Girginov, 2010). In modern sports, the actual management of organizational culture is one of the main practical tasks that sports psychologists, coaches, and managers must complete. The developments in that area are not simply creating organizational culture but creating an organizational culture that supports excellence

in sports achievements. (Cruickshank, Collins, 2012).

The classification of organizational cultures varies. One of the most popular is by E. Shain (2002). In terms of its accessibility to observation and analysis, the organizational culture is observed as a three-layered formation of artifacts and symbols (1), values (2), and a most profound and complex system of underlying assumptions about people, interpersonal relationships, and truth (3). Hofstede's other authoritative interpretation is on criteria such as distance from an authority, acceptance of indeterminacy, relation to community and individuality, assertiveness (masculinity-femininity), projection of the time horizon (Sheldrake, 2001).

Adhering to the research of Cameron and Quinn (2012), in the context of this study, organizational culture is perceived as a set of values and norms that, in an institution such as a sports club, are the basis for achieving adaptation to the environment and achieving inner integrity.

The theory of Kim Cameron and Robert Quinn that organizational cultures can be classified within a system of two criteria for efficiency is used for this empirical study. The first criterion differentiates efficiency based on values such as "flexibility, personal judgment, and dynamism" from efficiency based on "stability, order, control". The second criterion is the opposition between "internal organization, integration and unity" and "external orientation, differentiation, and competition". These criteria lay the foundation for the classification of organizational culture, also known as the competing value framework (CVF). The framework consists of four elements or types of organizational culture: clan, adhocracy, market, and hierarchy. (Cameron, Quinn, 2012). The organizational culture of a particular organization is never limited to one type only; the types co-exist and complete each other, each having a different weight within the framework. (Cameron, Quinn, 2012). The balance of the four types within an organization makes up the "*profile* of organizational culture," i.e., their stable configuration about particular factors with significant influence on the configuration.

Aims and tasks

The concept of the empirical study lies within the framework of understanding the role of organizational culture and the interpretation of the crisis in Bulgarian football. The study focuses on the age group of 17-year-old youths. (Y-17).

The study aims to examine the three independent variables (factors) that play part in building an organizational culture within three football clubs.

The subjective opinion of 17-year-old players from three clubs on the following three variables was studied: *Success* of the team of the surveyed groups; Competitive *experience* of the surveyed persons. The three clubs differ in their team successes and the zones in which they compete.

METHODOLOGY

Problem

Based on the understanding of (1) the functions of organizational culture and (2) its significance in the building of sports teams and the overcoming of crises in football teams, we make the general logical assumption that at a young age, the development of football players should not be limited to sports-and-technical training but should also include building adequate organizational culture. However, this proves to be a difficult task. Definite research should be conducted regarding age and football practices to accomplish this task. Alas, in Bulgarian conditions, such studies are not

available. The characteristics of organizational culture in the clubs of children and adolescents who are training and playing competitive soccer are not discussed and reviewed. The factors that influence the development of organizational culture are not acknowledged. Also, no studies have been conducted on the problems that arise when the 'level' of organizational culture changes, e.g., when the players change the league they play in (move to a higher level) or go into professional football.

Hypotheses

The hypotheses are built on the basic values of organizational culture, which have an internal contradiction in their integrity. This is what gives grounds for applying the OCAI tool of Cameron and Quinn.

The hypotheses subject to exploration are:

We assume that the informants in the clubs are at such age that the profile of the organizational culture is formed under the influence of the following factors: 1) the competitive *experience*; 2) *successes* of the club in matches; 3) the vision of the subjects about their *personal sports future* in the team, hence, personal perspective is an important factor in the attitudes towards organizational culture.

Method

Hypothesis testing is based on information obtained through an adapted version of OCAI - Cameron and Quinn's competing values *instrument* (Organizational Culture Assessment Instrument). It checks the perception of organizational culture in two modes - actual and desired state based on six criteria: 1) dominant characteristics, 2) leadership, 3) personnel management, 4) organization solder, 5) basic strategies, 6) criteria for success (Cameron and Quinn, 2012). For each criterion, four statements that correspond to the *four types* of organizational culture (adhocracy, market, hierarchy, and clan) are formulated.

Cameron and Quinn's methodology was adopted because the value characteristics of these types of organizational culture are adequate to main football features: a leading role of teamwork in the club alongside the strive for individual performance; the strive for high achievements and victories, and the strive for defending the club's name and honor; coaching decisions, responsibility in the game and authority for personal decisions and actions; dual dynamics of the competitive environment – within the club and with other clubs (Tsvetkov, 2012).

The players and coaches are participating in the survey filled-in evaluation cards. Each of the six criteria distributed 100 points among the statements related to the four types of organizational cultures studied. The survey was conducted twice. The first survey aimed to evaluate the club's organizational culture as seen at the time of the study (*real* state mode). The second survey assessed the desired state in three years. The *desired* state actually expresses the desire for change. The chosen period is shorter than the one proposed by the original methodology because of the age of the subjects and the short time they have to move to the next age group of eighteen-year-olds (Y-18).

Factors

The empirical survey is based on a model that uses the types of organizational culture as a dependent variable. Following the hypotheses, the *factors* tested for their influence on the attitude of the participants/informants towards the types of organizational culture in their teams are determined.

1) *Success* (place in ranking) of the team of the surveyed groups. Success is a result of organizational culture, but it also maintains it by being part of it. Success and victories are part of the history, the symbolic assets, and the myths of the organizational culture of the club.

They are another name for the effectiveness of the club's play and its organizational culture. They become a factor that "returns" its influence through the attitude towards the dominant type of organizational culture and presents it diagnostically. The more the team succeeds, the more success develops and strengthens the team's climate, cohesion, goals, trust in the coach (Shaw, 2019, Honigstein, 2016).

The data about this independent variable was analyzed on a nominal club scale for the following clubs: the Pirin, Pirin 2001, and September.

2) Competitive *experience* of the surveyed persons. It is manifested not only in sports-and-technical improvement but also in internalized organizational culture (norms and rules, ideals and goals, beliefs, and authorities in the organization). It provides an opportunity for better knowledge and adaptation to the organizational culture and for influencing organizational culture through personal awareness, skills, achievements, contacts, personal authority. According to this factor in the analysis, all participants were divided along an interval scale into groups with competitive experience up to 3 years (n = 8) and over three years (n = 51).

3) Vision for a *personal future career* in the team. Personal prospects are essential for the attitude towards the organizational culture. If they satisfy people, they see their future in the organization and contribute to its preservation and development so that their personal future is stable and predictable. To track this factor in the analysis, the data about the entire sample was broken down on a nominal dichotomous scale into two groups: with an insecure and unclear future against a stable one and with good prospects in the team.

Scope of the survey

The research includes 60 athletes from group "adolescents – 17 years of age" and the three coaches of the participants' teams. All of them were familiarized with the experiment's methodology and knew how to use it. The coaches reviewed the research inventory and gave their consent for a field study with their teams. However, they were not present during the field study itself. The survey was anonymous, and the participants who gave their consent to voluntary participation in the study were included in it, worked independently and individually, and had no contact with the other respondents. They compete for the following teams: Pirin (n=19), Pirin 2001 (n=17) and September - Simitli (n=24). The mean age of the participants was over 17 years. Their competitive experience in the respective teams is between one and over three years.

The three teams compete in the regional youth group. They distinctly differ in their achievements, and this gives an opportunity to trace the influence of this factor on the organizational culture at the specified age. Their performance at the beginning of the survey (14.01.2021) was as follows:

- "Pirin", Zone 1., 19.09. – second place; 14.01.2021 – 12 matches played, third place. This is the team with the highest achievements/ results from the three teams in the survey and the one with the longest/ richest club history.
- "Pirin 2001" – Zone 2, 19.09. – sixth place; 14.01.2021 – 13 matches played, third place (Zone 1 has higher status compared to Zone 2).
- „September-Simitli" - Zone 1., 19.09. – thirteenth place; 14.01.2021 – 12 matches played, thirteenth place.

A variation of the same survey tool was used to conduct the survey with the coaches of the three teams.

The field survey with the players was conducted between the 19th of September and the 15th of October 2020.

Processing the results

The results obtained from the individual cards were processed with SPSS 23. ANOVA analysis was applied to verify the hypotheses. The requirements for applying the method were met (Ganeva, 2016): a) the observations were independent. b) the size of the groups participating in the survey was approximately the same (1:1,18:1,41); c) the factors and the variables correlated (Nikolova, 2004); d) the data were normally distributed, which was verified through the ratio of the asymmetry to the standard deviation (Table 1).

Table 1. *Distribution verification results*

Groups/cultures	Clan	Adhocracy	Market	Hierarchy
	Skew./ StDev.	Skew./ StDev.	Skew./ StDev.	Skew./S StDev.
Success		**Real state / Desired state**		
Pirin	.337 / .167	.307 / -.124	-.362 / .069	-.175 / .068
September	.177 / .251	.086 / .035	-.028 /-.214	.382 / .401
Pirin 2001	.174 / .047	.307 /.144	-.073 /-.194	-.010/ -.031
Experience		**Real state / Desired state**		
Up to 1 year	-3.728 / .331	.600 / .140	-.279 / .000	.000 / -.735
Up to 3 years	.273 / .116	.344 / .315	.206 / -.106	-.171 / -.170
Over 3 years	.221 / .208	.658 / .033	.038 / -.020	.586 / -.170
Position		**Real state / Desired state**		
Titular	.195 / .086	.662 / .009	-.100 / -.011	.609 / .073
Reserve	.350 / .425	.300 / .307	-.193 / -.260	.051 / .622
Perspective		**Real state / Desired state**		
Uncertain and unclear	.121 / -.009	-.060 / .166	.109 / .142	-.197 / .244
Stable with good perspective	.235 / .215	.664 / -.001	-.114 / -.324	.644 / .010

Note: *Skew. and StDev. denote asymmetry and standard deviation (Skewness, Std. Deviation).*

The descriptive statistics were calculated as well. Leven's test was used to verify the equality of variances (Homogeneity of variance test), at significance level $\alpha = .05$ and probability $\rho < .05$ for rejection of the null hypothesis (absence of effect). The test is independent of the assumption of normality of the distribution (Kratko …, p. 142). The significance of the differences in the averages was checked as well. Post-hoc tests and calculation of the magnitude of the effect (Cohen's η-coefficient) were applied to evaluate the differences in the groups regarding the role of the independent variables (factors) for the dominant type of organizational culture.

RESULTS

Table 2 shows the mean and standard deviation values taken from descriptive statistics *in general* for the sample of organizational cultures, organized by type and in descending order. According to the "strength" indicator (Cameron, Quinn, 2012), the hierarchical type, followed by the clan one, dominated the organizational culture profile in the *real* state mode. The evaluation of the *adhocratic* type provoked the highest level of disagreement, while the *clan* one – the lowest. The situation in the *desired* state mode was quite the opposite: the *clan* type led as measured by the "strength" indicator, followed by the *hierarchical* one. The *market* type evoked the most

agreement, while disagreements were mostly found with the *clan* type. The difference in the values of the average quantities between types taking the first and last rank in the *real* state mode and the *desired* state mode was 2.633 and 5.335, respectively. Moving towards an organizational culture profile in the future caused twice as much difference compared to the evaluation of the current profile.

Table 2. *Mean values for the studied types of organizational culture by modes*

Cultures	Real state		Desired state	
	Mean	Std. Dev.	Mean	Std. Dev.
Hierarchy	26.6158	6.809	28.5254	5.557
Clan	25.2684	4.901	24.3333	4.025
Adhocracy	24.0141	6.839	23.8955	3.658
Market	23.9831	4.266	23.1893	4.468

The dominant types in the *real* state mode outlined a profile with control over the internal environment – values, such as order, hierarchy, personal or collective authority, discipline and rules, security, and consistency. (While working with his players, one of the most successful football coaches in Germany, Otmar Hitzfeld, carefully built the psychological compatibility in the team, insisted on hierarchy, leadership exhibited by one or two players, discipline, and hard work (Honigstein, 2016). Conversely, the other two types of cultures with a focus on the external environment (flexibility, adaptability, competitiveness, search for solutions in dynamic and changing conditions) were weaker (The ordinance in both modes, verified by the Spearman rank correlation, revealed strong dependence (r_{sp} = .8). The market culture, which embodies individuality, was not the "strongest" but caused the least amount of disagreement among those evaluated.

The influence of the independent variables on the culture profile in both modes can be seen from the values obtained from two of the measures of the central trend – the middle and the standard deviation, shown in Table 3 and Table 4.

Table 3. *Mean values by factors, "real state" mode*

Factor	Groups	Cultures			
		Clan	Adhocracy	Market	Hierarchy
Success (ranking)	Pirin 2001	29.186	23.235	20.147	26.127
	September	23.854	24.208	24.653	27.028
	Pirin	23.454	24.491	26.713	26.528
Experience	Up to 3 years	25.708	24.896	21.667	26.875
	Over 3 years	25.199	23.876	24.346	26.575
Position	Titular	25.509	23.887	23.899	26.642
	Reserve	23.139	25.139	24.722	26.389
Perspective	Uncertain and unclear	21.5769	24.4487	26.3462	25.7051
	Stable with good perspective	26.3116	23.8913	23.3152	26.8732

Table 4. *Mean values by factors, «desired state» mode*

Factor	Groups	Cultures			
		Clan	Adhocracy	Market	Hierarchy
Success (ranking)	Pirin 2001	31,127	24,559	19,608	24,706
	September	28,102	22,361	25,231	24,306
	Pirin	27	24,576	25,231	24,09
Experience	Up to 3 years	30,208	26,458	18,75	24,792
	Over 3 years	28,261	23,493	23,886	24,261
Position	Titular	28,72	23,975	23,11	24,195
	Reserve	26,806	23,194	23,889	25,556
Perspective	Uncertain and unclear	26,0897	22,5000	25,3205	25,9615
	Stable with good perspective	29,2138	24,2899	22,5870	23,8732

The *market* type culture dominated the profile of the group with the best performing team based on "strength" according to the "club *success*" factor (the place in the ranking is the empirical indicator) in the "*real state*" mode. The *hierarchical* type led to the weaker performing team in the same zone, the *clan* one – for the team in the next zone. There was an equal distribution within the groups of both zones in the *desired* state mode – the clan type determined the profile.

Based on the *success* factor for both modes, ANOVA made a total of eight comparisons for the groups by culture types. Only three cases exhibited statistically significant differences (Table 5). For the "*real* state" mode, these were: 1) the *clan* type with a typical magnitude of the effect η (interpreted using Kohen – Ganeva, 2016), 2) the *market* type with effect η, more significant than the typical one. In the "*desired* state" mode with a typical magnitude of the effect η, a statistically significant difference was observed only in the case of the *market* type culture.

The post-hoc Tukey HSD test at ρ<.05 showed a statistically significant difference in the values obtained for the averages of the culture types in teams that not only take different places in the ranking but also compete in different rank zones.

a) *reality* state mode:

- *clan*, for the groups of: a) "Pirin" and "Pirin 2001" (Mean Difference (MD) -5.733, ρ= .001); b) "Pirin 2001" – "September" (MD – 5.332, ρ= .001);
- *market*, for the groups of: a) "Pirin" and "Pirin 2001" (MD – 6.56- 6, ρ= .000); b) "Pirin 2001" and "September" (MD -4.506, ρ= .000);

b) *desired* state mode:

- *clan*, for the groups of „Pirin 2001" and „Septemvri" (MD – 4.128, ρ= .001); b) „Pirin 2001" against „Septemvri" (MD – 5.332, ρ= .048);
- *market*, for the groups of: a) „Pirin" and „Pirin 2001" (MD 5.623, ρ= .000); b) „Pirin 2001" and "Septemvri" (MD – 4.587, ρ= .001).

Based on the competitive *experience* factor in the *real* state mode, the *hierarchical type* was stronger and dominant in the groups with

up to 3 years of experience and more than 3 years of experience (difference of 0.259 in favor of the former). The factor's influence was neutralized in the case of the *desired* state mode – the *clan* type of culture was the strongest in both groups (Table 4). ANOVA did not show a statistically significant difference between the culture types in the *real* state mode based on the *experience* factor. Such a difference ($\rho < .05$) was observed in the other mode, but only for the *adhocracy* and *market* type of cultures (Table 4 and Table 5). The hypothesis was only partially confirmed.

For the "*personal prospects"* factor in the *real* state mode, the *hierarchical* and *market* type of culture defined the group's organizational culture profile, assessing its prospects as *stable* and *good* and the group that evaluated their prospects as *uncertain* and *unclear* (Table 3). For the *desired* state mode, the *clan* type was the leading culture type for both groups (Table 4). The difference in evaluating the perspectives for the *clan* and *market* types of culture was statistically significant only in the *real* state mode. Still, in both cases, the magnitude η of the effect was less than the typical one (Table 5). The hypothesis was only partially confirmed.

Table 5. *ANOVA-results*

Cultures / Mode	Factor	df	F	Sig.	η
Clan, Real state	Success (ranking)	2.56	10.062	.000	.264
Market, Real state	Success (ranking)	2.56	16.744	.000	.374
Market, Desired state	Success (ranking)	2.56	10.575	.000	.274
Market, Desired state	Competitive experience	2.56	10.659	.002	.158
Adhocracy, Desired state	Competitive experience	1.57	4.844	.032	.078
Clan, Real state	Perspective in the team	2.56	11.1097	.002	.163
Market, Real state	Perspective in the team	2.56	5.51359	.022	.088

Note: $\rho < .05$

The survey results obtained from the coaches (Table 6) showed that the leading types of culture for both modes were the same. The *hierarchical* type was dominant for the coach of the best performing team, while the *clan* one was dominant for the team coach that performs the worst.

Table 6. *Organizational cultures, coaches (No.= 3)*

Cultures	Modus: *Real state*			Modus: *Desired state*		
	Pirin	Pirin 2001	September	Pirin	Pirin 2001	September
Clan	20	24.16	32.5	25.83	22.5	34.16
Adhocracy	23.33	21.66	20.83	27.5	23.33	22.5
Market	22.5	28.33	19.16	19.16	29.16	20
Hierarchy	34.16	26.66	27.5	27.5	25.83	25

DISCUSSION

Organizational culture – general profile

Adolescence establishes a sustainable selective attitude towards the environment with its cultural values and their internalization by the individual (Kon, 1980). The results confirm that the organizational culture profile imposed in the three clubs is subject to a pronounced value attitude. The practical consequence for the coaches is that they need to know the profile of the organizational culture and the expectations thereof and consider those expectations while working on the organizational culture and personal development of the athletes.

The theoretical formulation that there is no such thing as proper organizational culture can be seen in the two models' evaluations under research. The evaluation of the organizational culture profile of the present state evokes more agreement compared to the vision of the future change. The experience, whereby the influence of the coach and the "inherited" culture is quite strong, provides the necessary confidence in assessing the present state. When choosing the *desired* organizational culture profile, subjective differences tend to manifest, and referring to the experience tends to be more hesitant (the data are significantly scattered).

The objectified dominant culture types in the *reality* mode are the reason to think that the subjects accept them as adequate to the characteristics of football and adapt to them. This is part of their socialization and sports growth in an environment with pronounced internal control and significance of achievements. Coaches apparently feel comfortable exercising authority. It provides opportunities to promote their ideas about the team and the players' personal and athletic growth. The significant dispersion in the evaluations of the leading types reminds that control over the internal environment brings its own set of risks of obsession with authoritarianism (Ilyin, 2012) with concomitant addiction among players (Lozhkin, Volyanyuk, Kolosov, 2009, 2017). Though less "powerful", the market and the adhocratic type evoke more agreement. The situation reminds of how important it is for coaches to consider the power of the real culture types.

The differences in the dispersion for the *two different modes* (Table 2) points to the subtlety of the balance of managing change in the organizational culture profile. Coaches are under pressure to maintain control over the internal environment (Table 6), which provides a real security and promotes openness to competitiveness, individualism, and autonomy. Achieving efficiency and improving results go "hand in hand" with effective management of the organizational culture profile given the specific conditions in the teams.

Coaches are still under pressure, which comes from the expected transition to an upper age group. They are a factor in managing this change and have resources (personal authority and institutional values and history; formal position). But managing the changes in the organizational culture profile takes place in conditions of uncertainty and the different subjective expectations of the players. Therefore, coaches need to be aware of these expectations and carefully consider their value and practical dimensions. Preparing for such a change is essential to avoid the "culture shock" that occurs when transitioning towards professional football culture and successful sports and competitive development.

Collective success – organizational culture

The successful performances of teams that make up the groups are partial confirmation that this is a factor shaping the profile or organizational culture. The fact that better efficiency (successful performances) is associated with stronger *market* type culture highlights the role of the acceptance of its core values. However, the market type creates tension not only among the players but also between them and the managers. This brings fatigue and affects the collective nature of the game, which leads to a desire for a shift towards clan culture. Conversely, the security and control of the environment, exhibited both by the clan and the hierarchical culture type, are "strongest" in the team that performs the worst. A similar arrangement of the types is observed in the case of the coach. It is possible that a lower rate of successful performances makes this profile more suitable for maintaining stability as a prerequisite for the eventual improvement of the rate of success.

Dialectics lies in the balance between the tension created by the aspiration for competitiveness and great results and the security which comes as a result of the control over the internal environment. Looking at such a dialectic from a phenomenological point of view, Simon Critchley notes that football is a team sport, where individuality manifests and develops itself through organizational structures and their respective cultures (Critchley, 2017).

As for the coaches, the results outline two strategies: a) *security and internal control* – the study shows that it is relevant to teams with weaker results. It aims to maintain the internal support between players and their trust in the coach as means of improving the game efficiency. The other strategy is a balance between *teamwork* and *competitiveness* inside the team, which aims to make players compete for the best results. This shows that building a profile of organizational culture compatible with the goals set is just as important as focusing on sports and technical development.

Experience in competitions – organizational culture

Socio-psychological research shows that the more stable the attitude towards oneself based on experience and reflexive thinking is, the more critical the attitude towards external figures of authority is (Mayers, 2010, Ogorodova, 2013) and cultural influences. These frameworks help explain that the competitive *experience* factor, *reality* state mode in both groups (with experience up to three years and over three years) is associated with more significant influence of the hierarchical type, more pronounced in the first group (the difference in the average values was .259). The other mode exhibits a preference for change to *clan* type (Table 4) – security is found in the group and verified during competitions and training. However, both types are characterized with strong control over the internal environment.

The absence of statistically significant difference of the experience factor for culture types in the *real* state mode refers again to the leading role and complementarity of the culture types of the internal control. The gradual change of this profile can be seen in the fact that the two groups of organizational cultures in the *desired* state mode – market and adhocracy – connect with the age of the future changes under examination, albeit with little force. The accumulation of experience leads to a more pronounced preference towards the

market type of culture, which advocates for values, such as individuality and competitiveness (Table 4 and Table 5).

Position in the team – organizational culture

In the motivational structure of the sport, the aspiration for recognition is realized through competition. In a team sport, such as football, recognizing the player's individual contribution is reflected in the *position* the individual player receives during the game – e.g., starter or substitute. The competition for landing a specific position and its affirmation through its accompanying role in the team is a typical way for self-realization and self-actualization in the sport (Ogorodova, 2013). It is therefore surprising that the assumption of the importance of the position *starter* or *substitution* was not confirmed. In the specific age and institutional situation, it does not appear to be a factor that divides the sample of culture types under investigation in a statistically significant way.

The "starter-substitution" position in football is associated not only with individual accomplishments but also with the coaches' decisions (Tsvetkov, 2012). It is a typical practice for coaches to change the positions of adolescent players in the structure of the team game to find the best team and personal game solutions. Thus, they also maintain a certain degree of uncertainty, which is part of their motivation strategy. The challenge lies in the boundaries, which allow for maintaining the security-insecurity balance in athletes. If the coach's assessment regarding the individual contribution and effectiveness of a player unfairly and subjectively keeps him in an unstable position (in this case, the positions under research), this contradicts the subjective self-assessment and affects the motivation for playing and achievements (Ogorodova, 2013). It affects the judgments about the organizational culture and violates the trust in its values. Given the collective nature of football and the outlined complementarity in cultures, it is possible that might be a factor of greater importance for acceptance of culture types with reduced critical disposition compared to focusing on the role of individual achievements and rewarding those with the position in the team. This reduced critical disposition imposes a negative projection on the motivation for personal affirmation and development, rewarded by landing a position that is adequate to the individual contribution to the team. Therefore, the influence of the coach in determining the position that brings recognition ("starter") appears to be an element of the coach's strategy with dual but complementary projection: sports-and-technical development and its fostering in the adolescent football players and affirming a particular profile of organizational culture.

Personal perspective – organizational culture

The group of those assessing their prospects as uncertain and unclear usually build a profile with predominantly market type of culture and lean towards change to *clan* type. The reason is to be found in the understanding of reality, in which the only way to distinguish yourself is through competition. The preference for clan type is the hope to overcome the uncertainty of the competitive type of culture through support and security provided by the community. Conversely, the *hierarchical* type consolidates the security of the position in the present for those who see themselves stable and with good prospects. In contrast, the *clan* type provides

the same security in the future (Table 3 and Table 4). The perspective factor divides the two groups with only a slightly significant effect for the *clan* and *market* type and only for the real mode, which shows the complexity of perception of the different cultural values. This is even more relevant for the *hierarchical* and *adhocratic* types of cultures, where the difference is not even statistically significant.

In terms of practice, the subjective assessment of the personal perspective does not lead to unambiguous strategies for managing the profile of the organizational culture. One of the available strategies is associated with building the profile through similar and complementary values. It probably creates fewer values and personality conflicts. The second one relies on differentiating cultures by focusing on the coaches' goals to improve the game's efficiency. It is essential to note the tension created by the support of the coaches for the targeted cultural profile and the resistance of the supporters of the one that has already been established. Experience and research show that the second strategy is more challenging to implement and is met with more resistance on the part of the players. It is also not always successful for the coach – in fact, he is often sacrificed to keep the status quo in the organizational culture.

CONCLUSION

The results show that the organizational culture in the age group under investigation is subject to evaluation and design in the future (our general logical assumption). This provides perspectives for coaches, who should not ignore its existence in their work and must also build their strategy for its consolidation and modification over time. They might also consider their strategies in terms of their players' future with whom they work in the field of professional football.

The organizational culture profile in the *current mode* is more focused, while the visions for its future provoke more disagreements. The profile in both modes is dominated by the clan and hierarchical cultures, in which the coach's control over the internal environment is strong. They tend to be more oriented towards stability, internal cohesion, support, demands, discipline. The adhocratic and market type of culture takes a back seat. However, they are rated significantly higher by the team players that show the best results during competitions. This indicates that managing change in the organizational culture is essential for improving game efficiency and results in the competitions.

On a practical level, it is essential that organizational culture change meets resistance from the established ones. Therefore, coaches should consider its positives cautiously and, with the time perspective before them, promote the desired organizational culture change. It is also important to note that transitioning towards competitions in higher age groups is associated with enhanced game efficiency requirements, which should come with an adequate organizational culture. This could be a severe motive in the coach's work with his athletes.

Coaches are more confident in responding to the different types of organizational culture in the two modes and change only their strength, which in turn provides for better stability of their position. They encounter an organizational culture profile that is typical for a team sport and have a wide range of opportunities to influence the training activity through the factors indicated above, thus guiding the

organizational culture in the clubs from early adolescent age while still meeting the expectations of the athletes. It is always important to consider that organizational culture is a factor that carries the risk of suppressing the expressions of individualities. To the extent that the personality-organizational culture contradiction is a factor in the development of the last, this has the risk of rigidity of the same when it might be time for changes in the organizational culture.

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Corresponding author:

Trayan Popkochev
Pedagogy department
South-West University "Neofit Rilski"
Blagoevgrad, Bulgaria
E-mail: popkochev@outlook.com

CARL DIEM – A SIGNIFICANT SPORTS PERSONALITY FOR GERMANY, EUROPE, AND BULGARIA

ATTEMPT AT ANALYSIS AND ASSESSMENT

Jörg Schenk
National Sports Academy "Vassil Levski", Sofia, Bulgaria

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ORCID
Jörg Schenk
https://orcid.org/0000-0002-9882-3739

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ABSTRACT

The German Carl Diem is considered one of the most outstanding sports personalities and Olympic promoters of modern times and was not only relevant to sports development in and for Germany but also abroad. His work unfolded especially in the first half of the 20th century but led to highly contradictory assessments of his person and his work due to the circumstances of the time and political developments in Germany and Europe. It becomes apparent that in contrast to Germany, where Diem is now almost forgotten despite an almost incalculable oeuvre and is only known to sports historians, in Bulgaria, where he created the essential basis for the establishment and structure of the "State Higher School for Physical Education", later "National Sports Academy 'Vasil Levski'", and thus the academic training of sports teachers with his "Organizational Plan for Physical Education in Bulgaria", there was initially no mention of him after 1944 and only from the 1990s of the last century at least some few mentions. This article uses an overview of the academic literature to shed light on Diem's changed reception in Germany as well as the deficient research situation on him in Bulgaria.

Keywords*: Carl Diem, Organizational plan, Higher School of Physical Education, Bulgaria, Olympia*

SUMMARY OF RESEARCH PROBLEM

The XI Olympic Games (Berlin 1936) and the Olympic Winter Games in Garmisch-Partenkirchen in the same year marked a special moment in the history of sports in the 20th century. Their organization per se, as well as their dimensions in terms of the participating nations, the number of new Olympic and world records, the sports facilities, and their media impact, etc., on the one hand, as well as the instrumentalization of the Olympic Games as an element of party-political propaganda aimed at the exhortation of the all-powerful system in Germany, on the other, assumed unprecedented proportions.

The conception and organization of the 1936 Olympic Games were the work of Carl Diem (1882-1962). Carl Diem was a prominent sportsman, educator, sports researcher, manager, official, and journalist of international importance. For political reasons, he was officially only second-in-charge as the "Secretary-General", after Theodor Lewald, the Chairman of the Organizing Committee (OC) and former Chairman of the German Imperial Commission for Physical Education (Deutscher Reichsausschuss für Leibesübungen).

Along with his undisputed qualities as a sports manager, Carl Diem is considered the most significant supporter of the Olympic idea and the Olympic Games. He was a follower of Pierre de Coubertin, making him a natural authority in the preparation and organizing of

the 1936 Olympic Games in Berlin and the IV Winter Olympic Games in Garmisch-Partenkirchen. Undoubtedly, something which is inevitably associated with Carl Diem but not sufficiently known is the introduction of one of the most important ceremonies in the Olympic Movement. Until 1936, the Olympic flame was lit at the stadium during the official opening of the Games. Inspired by several ideas which are still disputed even today, Carl Diem developed a program to carry the Olympic flame from Olympia, the ancient capital of the Olympic Games, to the current capital of the Olympic Games - in this case, to Berlin for the first time in 1936, as a "torch run". This large-scale international sporting event which even today is regarded as a canonical element of the Olympic Movement was carried out at the order of Joseph Goebbels together with Theodor Lewald.[1]

If until 1936, Carl Diem was an unconditional sports personality and organizer who laid the foundations for the entire system of the sports movement in Germany based on mass involvement of the population in systematic physical activities through development of communal based structures of sport organizations and the building of public state sports facilities through the organizational unification of sports clubs and societies, the huge impact of the Olympic Games in Berlin as a manifestation of the Olympic sports culture brought Carl Diem to international prominence.

After the 1930s, through his involvement with the Olympic Movement, although not a member of the IOC[2], his views and achievements in organizing the sports movement became extremely popular, above all abroad. For example, he was responsible for a comprehensive reform of sport in Turkey and also assisted other European governments in building modern educational and organizational structures in the field of sport.[3] Bulgaria also belongs to the countries where his contribution to reforming the system of physical education and sport, one of which, for example, is of great importance today, was the establishment in 1942 of the National Sports Academy, then the Higher School of Physical Education.

In Germany itself, Carl Diem left his mark

1 There are a range of views underlying the idea of this ceremony. Overall, the authorship of torch running is indeed attributed to Carl Diem. For now at least, and according to the overwhelming majority of academics, this is in fact probably based on an idea and initiative of archaeologist Alfred Schiff, administrative director of the Berlin German University of Physical Education, founded in 1920 in Berlin. See also Lehmann, S. (2008). (invoked on 14.08.2020). Hristova, D. (2012). She raised the question of Bulgarian authorship, but apart from rather weak assumptions by academics and the fragmented memories of individual witnesses of the time, she failed to provide convincing evidence that the idea of the torch run was born in Bulgaria.

2 Diem's enthusiasm and commitment to sport was not only of a purely idealistic nature: even as a young man, he had written on sporting topics for various newspapers and publications for a fee, thus financing his livelihood and various trips to major sporting events. This resulted in competence and publicity, which brought him to full-time positions professionally, e.g. Secretary General of the German Imperial Commission for Physical Exercise („Deutscher Reichsausschuss für Leibesübungen", a kind of umbrella organisation for sports in Germany; abbr. DRA, DRL or more rarely DRAfL), Vice-Rector of the German Higher School for Physical Exercise or Secretary General of the Organising Committee of the Olympic Games in Berlin. This led the IOC to consider him a „professional" and not to let him become a member. Cf. Krüger, M. (2012), pp. 204.

3 In the 1930s in particular, Carl Diem undertook numerous, partial repeat visits for researching the models and systems of organization of sport and physical education not only to the US and Japan, but also other European countries, including Great Britain, Belgium, Italy, Austria, Switzerland, Norway, Sweden, Finland, Hungary, Greece, Turkey and Bulgaria. See also CuLDA (n.y.). Gesamtverzeichnis Tagebücher Carl Diem.

on German sports and, in particular, Olympic sports for more than six decades within the framework of four German systems of government:

- during the German Empire
  - Imperial period, 1905-1918
  - 'Weimar Republic', 1919-1933
  - 'Third Reich' (National Socialism), 1933-1945
- and after the Second World War during the Federal Republic of Germany since 1949 until his death in 1962.

It is here that he enjoyed great recognition for his achievements in the field of sport organization for example the attempts at unification of the two most important physical culture organizations in Germany at that time.[4] He also launched the so-called youth competitions of the Reichsjugendkämpfe (later in the Federal Republic of Germany Bundesjugendspiele, „Federal Youth Games"), the introduction of the German Sports Badge[5], which even served as a prototype for the establishment in the Soviet Union, and hence all its satellites (in Bulgaria in 1948) of the fitness program "Prepared for Work and Defence". (Commission on Dossiers - COMDOS (Ed.) (2014), Mitev, (1996a). He was also instrumental in the establishment of the German Higher School of Physical Education (DHfL) in 1917-19, the organization of the Games of the XI Olympic Games (Berlin 1936), as well as the first Olympic Torch Run, international consultancy activity, was one of the promoters of the reconstruction of the ancient stadium in Olympia/Greece and founder of the International Olympic Academy in 1961, etc.

His activity and his personality, however, have been the subject of serious analysis and totally different and radical assessments affecting not so much his activity as a persona but his political behavior. For more than 60 years, therefore, the research and discussions of his activities and contributions in Germany have led to political and ideological disputes, which in one way or another influence not only the objective assessment of his life. These circumstances still form different attitudes and assessments towards his activity as a sports leader and functionary. Indeed, there is also a tendency for the specific indisputable contributions that he left as a legacy to the sports movement to this day to be concealed or downplayed for various political reasons.

AIMS AND OBJECTIVES OF THE RESEARCH

In Germany, Carl Diem has been perceived not only positively, but also critically, even inimically, by his contemporaries and subsequent generations. This is determined by his extraordinarily ambivalent political behavior (or lack thereof) in the conditions of the Nazi regime in Germany. This ultimately makes him, as well as his political life and work so

4 The attempts to unite gymnastics and sports movements at the beginning of the 20th century, the German Gymnastics Association, which drew on F.L. Jahn and cultivated civic-national ideals, on the one hand, and the German Imperial Committee for Olympic Games, which emphasised the idea of competition and performance, on the other, was ultimately short-lived and ended as early as 1923/24 with the „Clean divorce", the separation of modern sports on the one hand and gymnastics on the other. Cf. Krüger, M. (2009) and Stępiński, M. (2015).

5 During the Olympic Games in Stockholm in 1912, Diem became familiar with the sports badge awarded in Sweden („Idrotts-Märket", 1907) and incorporated this into his sports badge initiative. This badge has undergone several renamings over the decades. In Germany nowadays the "German Sports Badge" ("Deutsches Sportabzeichen") is awarded.

controversial and vulnerable, not only in life but especially after his death.[6]

The present study does not focus on the search for biographical discoveries and participation in this discussion.[7] However, a detailed study of his activities in Bulgaria is aimed at the objective presentation. It also aims to provide an overview of the contemporary situation regarding literature and research relating to Carl Diem in Germany and abroad, which would give wider opportunities for assessment of the significance and impact of his work in Bulgaria.

ORGANIZATION AND METHODOLOGY OF THE STUDY

This study covers several main areas of information gathering. First of all - studies of documents and information related to the life and activities of Carl Diem in Germany and Europe, including Bulgaria. Secondly, it requires a very thorough review of the existing research of historical, political, biographical, sports, political and organizational nature, related to the presentation and evaluation of Carl Diem's activity as a sports activist and manager.

The particular contribution of this research is that it covers studies by authors from Germany, Europe, and Bulgaria. This necessitated research into documents from the Carl & Liselott Diem Archive (CuLDA) at the German Sport University Cologne (GSU Cologne) / (Deutsche Sporthochschule Köln (DSHS Köln), a number of libraries in Germany, as well as specialized literature in the Historical Archives of the NSA, the National Library "St. Cyril and Methodius", State Archives – Sofia, etc.

In methodological terms, the documentary information and systematic information collated from scientific and popular publications were examined on the basis of the so-called "content analysis", critical and comparative analysis.

Analysis and evaluation of Carl Diem in literary sources

REVIEW OF STUDIES IN GERMANY

There are countless literary sources and research about Carl Diem, as well as his own written legacy, especially in the German language.

Diem himself left behind him an extremely extensive collection of written work kept in the archive „Carl und Liselott Diem-Archiv" (CuLDA), formerly „Carl Diem Institut" at DSHS Köln, founded in 1964 by the German National Olympic Committee as an Olympic Institute.

This legacy encompasses a huge number

6 Jungbauer, A. (2004). „In addition to his publications „Sturmlauf durch Frankreich", 1941, and „Olympische Flamme", his speech of 18 March 1945 was very often addressed: „Before the members of Hitlerjugend and of Volkssturm in the Dome Hall of the Berlin Olympic Complex, Carl Diem made the so-called "Speech for Sparta" and called for a *‚final sacrifice in the name of the Fuhrer'*. While Soviet artillery fire could already be heard in the capital, Diem compared the youth of the National Socialist state to the militarized youth of Sparta and quoted the ancient Greek poet Tyrteus with the words *‚It is a beautiful death when the noble warrior fights for the fatherland, dies for the fatherland'*. In the days following the address, which historian Frank Becker decades later would describe as an „encouraging speech", hundreds of young men died in the battle for Berlin trying to use hand firearms and anti-tank hand grenade launchers to deter the tank units of the advancing Soviet troops.", (invoked on 22.12.2020) Cf. Krüger, M. (2012); Benz,W. (2011). Laude, A., Bausch, W. (2000).

7 This publication is part of a monograph on the work of Carl Diem in Bulgaria in the 1930s and 1940s.

of publications, speeches, reports, journals (ca. 12,000 pages), letters and correspondence (ca. 50,000 separate letters), as well as specific files in relation to his various activities as a functionary, photo albums, testimonies, and other written materials.

The primary authors who have studied the life and work of Carl Diem are Michael Krüger, Frank Becker, Karl Lennartz, Horst Ueberhorst, Wolfgang Benz, Jürgen Buschmann, Achim Laude, Ralf Schäfer and others. It can be assumed on the basis of the general concepts that:

In his lifetime, Carl Diem was considered a man who despite his national-conservative thinking was politically very adaptable, and in his professional sphere of sports, was considered an innovative and creative sports leader.

In order to get a better idea of the person of Carl Diem, it would be appropriate, first of all, to focus on three aspects: Diem as a politician and state leader in the field of sport, distinguished by great adaptability and flexibility to those in authority and with responsibility for political decisions; secondly, as a sports ideologist committed to his views on sport and to his doctrine and finally as an innovator and creator of organization and management of the sports movement. Thus, was he able to create the foundations of the state and social model of physical education and sports systems, still relevant to this day. They continue to have an impact on what Spyros Kapralos, the President of the EOC, defined as the European model of sport in terms of the academic and organizational aspects of modern sport. (Kapralos, 2019, European Parliament, 2012)

Diem acquired an important place in science due to his wide range of written works on sports history and theory. One of the most significant of these was "World History of Sport", but most of his works were accomplished during and after completing his mandate as the Vice-Rector of the German University of Physical Education (Berlin, 1920-1933) and later as Rector of the German Sports University founded in Cologne in 1947.[8]

Some of them are to be found in the following monographs, which subsequently rank among his more significant works:

- Olympische Flamme. Das Buch vom Sport, 3 volumes, 1942 [9]
- Asiatische Reiterspiele. Ein Beitrag zur Kulturgeschichte der Völker, 1941
- Körpererziehung bei Goethe. Ein Quellenwerk zur Geschichte des Sports, 1948
- Lord Byron als Sportsmann, 1950
- Weltgeschichte des Sports, 1961
- Ein Leben für den Sport. Autobiographie, editiert aus dem Nachlass von Carl Diem, (1974)

In 1967, under the title "Carl Diem - Der olympische Gedanke" (Published by Carl Diem Institut, 1967), a collection of speeches and writings was published to define the

8 Diem himself had neither studied nor defended a doctoral thesis, and muchless was a qualified professor. His appointment as Vice-Rector became possible after Theodor Lewald managed to appoint sports-loving medical doctor Prof. Dr. August Bier to the position of rector of that newly established Higher School, who in turn expressed his gratitude by awarding in 1921 Carl Diem, his deputy, the title „Dr. med. h.c." of the University of Berlin. In 1932, Ferdinand Sauerbruch, another world-renowned surgeon, succeeded Bier as rector. Under pressure from the "Reichssportführer" Hans von Tschammer und Osten, Diem resigned from his position as prorector at the beginning of May 1933.

9 This work is considered one of the most important testimonies of the time of National Socialist propaganda in the field of sports.

essence of the Olympic idea and principles, fundamental to the further development and explanation of Coubertin's ideas.

However, this is not an exhaustive review of the literature about Carl Diem. While Diem was still alive, an extensive, and initially largely positive commentary and analysis of his work was begun. This changed in the early 1950s, when his pre-war activities, particularly those in the field of politics, began to be increasingly critically questioned. However, particularly in the last 30 years or so and especially in the field of sports history, there have been a large number of academic developments, studies, works, and other publications in which Carl Diem has been mentioned predominantly critically. Today, after Diem's death this type of reception is garnering an increasing number of supporters and has a much broader public impact.[10] As a result, many cities in Germany have seen streets, squares, schools, and sports facilities renamed.[11]

The conflict concerning the correct interpretation of his activities and their implications for the development of sport, in general, became particularly clear in the writings of Diem's critics and other renowned academics on the occasion of the Congress of the German Sport University Cologne on 10 and 11 December 2010 on the theme "Culture of Memory in Sport".[12]

The so-called "Debate on Diem" was in general terms focused primarily on Diem's political behavior, his inclination towards subordination, and his ability to deal with those in power, particularly during the period of National Socialism. It is from this point of view that the organizational aspects of his activities were also highlighted.

Today in the historical analysis of the life and work of Diem, the biography entitled „Den Sport gestalten. Carl Diems Leben (1882-1962)" by Frank Becker, originally published in four volumes, but the most recent edition of 2019 published in a single volume, is valid in that it sets out the direction for analysis of his life work, but it is by no means the "only correct", or indisputable version.[13] It was commissioned by the German Olympic Sports Federation which challenged it at first. Due to its exceptional detail, this biography has also been used in this article as one of several essential sources of reference. Other well-known critics of Diem include, for example, Ralf Schäfer, Wolfgang Benz[14], Achim Laude, and Wolfgang Bausch, who question whether Diem is suitable to serve as an example

10 Cf. Lohde, E. (2013). The author herein describes four phases of the debate after 1950. However, the aforementioned "Debate on Diem" is not the subject of this review.

11 The German Sport University Cologne lost a lawsuit that was filed due to the renaming of its street from Carl-Diem-Weg to Am Sportplatz Müngersdorf.

12 Mentel, Ch. (2012). „Prof. Dr. Frank Becker has been teaching newer and newer history at Duisburg University since 2011. Since 2005, he has been working on the three-year research project „The Life and Work of Carl Diem" […], awarded by public competition from the German Sports Federation, respectively. The German Olympic Sports Federation and the German Sport university Cologne, whose founding director was Diem. […] After the completion of the project and during the publication phase, an open conflict ensued between Becker and several representatives of the Academic Council with regard to the research project, […] which in their final project report [qualified] Becker's work as academically unsatisfactory." (invoked on 08.02.2021).

13 „Based on a public evaluation published on 1 February 2012 by the German Olympic Sports Federation, Becker's recommendation with regard to the memory of Diem became a guide to its own position in the Debate on Diem." Text of the publishing house to the third edition of „Den Sport gestalten" (2019) Duisburg.

14 Benz, W (Edit.) (2011). Until 2011 W. Benz had for many years been director of the „Centre for the Study of Anti-Semitism" at Berlin University. In 2020, not for the first time, as a result of a number of speeches he had made, found himself the focus of criticism of anti-Semitism, accusing him of „belittling anti-Semitism".

or worthy to be remembered. For example, they accuse him of subconscious anti-Semitism, even open manifestation of such, as well as of a largely uncritical attitude towards the ruling systems, in particular National Socialism. This cumulates last but not least in his "Speech on Sparta" at the end of the war, which, in their opinion, calls his essential activities into question and justifies criticism of them.[15]

In opposition to this group of so-called "critical historians" there is another group which they and their supporters somewhat disparagingly refer to as the group of "Diemologists" or "apologists of Diem". Renowned scholars such as Michael Krüger, chairman of the Scientific Council, Karl Lennartz, former lecturer at the German Sport University and long-time head of the CuLDA, or Ommo Grupe, founder of modern sports pedagogy and sports science based on philosophical anthropology advocate a more positive point of view to Diem's work reproaching their opponents for their scientific errors. (Krüger, (Edit.) (2012).; id. (2010))

The true achievements of Carl Diem, the unification of gymnastics and sport, the imposition of a positive understanding of sport, the promotion of the Olympic idea, modern achievements in the field of organization and politics of sport, and last but not least his contribution to the history of sport, however, are almost unquestioned by critics. Perhaps it is these undeniable successes and achievements, that are the reason why, from a modern perspective, his political behavior seems so much more questionable and deserving of criticism.

In conclusion, it should be emphasized that both sides in the discussion acknowledge the importance of the contributions of Carl Diem have not only national but also international significance. The differences in positions relate to the extent of this recognition and the details of knowledge about him and his assessment.

In this sense, there is undoubtedly academic consensus that the achievements and contributions of Carl Diem are of great importance for the development of the sports movement in Germany and Europe, as well as his undeniable contribution to the development of the Olympic movement. It is no coincidence that in 1956 he was awarded the most prestigious award of the IOC, the Olympic Diploma of Merit, for his special contribution to the Olympic Movement.[16]

The second important issue concerning the clarification of Carl Diem's activities in Bulgaria remains unstudied by German historians. In this sense, this warrants in-depth research in this regard in the aims of enriching the existing research literature.

Bulgaria

In this context, there seem to be relative sparse academic works on Carl Diem in Bul-

15 Carl Diem's ideas and behaviour bear the clear imprint of national conservatism. Although he was not a supporter of the National Socialists and was even under suspicion by them because of his marriage to the "quarter Jew" (a slang term of the time) Liselott Diem, maiden name Bail, as well as his "friendship with Jews", the ambitious and opportunistically adaptable Diem managed to adjust to the conditions of the Third Reich. Proof of this is his appointment in 1939 as Reichssportführer Gau Ausland (Reichssportführer of the Region (Gau) Abroad) - an official post in the National Socialist power apparatus.

16 This award, founded in 1905 by Pierre de Coubertin for exceptional contributions to sports and the Olympic ideals, was granted a total of 57 times between 1908 and 1974. Since 1975 in accordance with its award statutes the IOC instead recognises outstanding services to the Olympic Games with the "Olympic Order".

garia. In Bulgarian sports historiography of the 1960s and 1970s, he is mentioned as one of the advocates of bourgeois sports ideology against which socialist sport was engaged in an ideological struggle. He was mentioned in the works of Vasil Tsonkov, Nikola Popov, Natalia Petrova, and Angel Stoychev. In recent times, after the political changes in Bulgaria, the activities of Carl Diem have been presented in a very limited scope in the research work of Rayna Bardareva with regards to the establishment of the National Sports Academy. Lozan Mitev in his dissertation examined the activities of Carl Diem as the first propagandist of the Olympic idea in Bulgaria and as a reformer of sport in Bulgaria. (Mitev, 2002)

The reason for this may be multi-layered. Indeed, Diem visited Bulgaria on a number of occasions, according to reliable reports in 1933, 1937, 1939, 1940, 1942, as well as passing through in 1943 and 1944 on his way to Turkey.[17] However, his activity acquired importance and necessity of a complex reform of the educational system in the field of sport. This took place during the war and therefore under restrictive conditions and against the backdrop of the subsequent total change in the dominant public order.

What were the reasons for Diem's visits to Bulgaria? As Bulgaria grew politically, economically, and culturally closer to the German Reich after the mid-1930s, and especially after the 1936 XI Olympic Games, German sport as a whole, but also the way in which it was organized, in particular training, became increasingly the focus of the attention of those responsible for political decisions in Bulgaria. (Zlatarski, 2020[2], Hoppe, 1979, Stein, 2011). Tsar Boris III himself, from the beginning of July to the beginning of September 1936, embarked on a long journey through Europe, which, like his earlier journey in 1934, took him back to Berlin, this time to these very Olympic Games. Whether or not he met Carl Diem there, is unclear. In any case, the Bulgarian team did not perform very successfully at these games, resulting in attention being focused on a radical reform of physical education and sport. (Mitev, 2014, pp. 70; Hoppe, ibd., pp. 47)

Thus, advice and support were requested from the German government, which complied with this request by giving Diem's employer, Reichssportführer Hans von Tschammer und Osten, leave of absence to carry out this task and send Diem to Bulgaria. (CuLDA: *Carl Diem Tagebücher*. pp. 1344). He arrived in Sofia in September 1937.

Carl Diem was already a recognized sports personality at the time of this visit to Sofia, which was to prove the most important one for Bulgarian sport. He had proven himself with his wide-ranging broad knowledge in the eyes of the German government and many foreign observers.

Another decisive element in the choice of Carl Diem as a government adviser was the fact that since 1932 he had worked closely with Stefan Chaprashikov, honorary chairman of the BOC and prominent member of the International Olympic Committee.[18] Chaprashikov was at that time Bulgarian ambassador to Ber-

17 The visit by plane planned for November 1941 had to be cancelled due to the weather situation.

18 Stefan Chaprashikov, a wealthy Bulgarian industrialist and diplomat in Berlin, Vienna and Moscow, etc. and close to the Bulgarian royal court, in September 1929 in Lausanne during the 28th session of the IOC was elected as a member and held this post until his suicide in 1944. In 1936, he obtained from the German Reich through Philip F. Reemtsma a donation of 20,000 Reichsmarks, which allowed the Bulgarian athletes to take part in the Olympic Games in 1936.

lin and had organized Carl Diem's 1933 visit to Sofia. It is important to note that Stefan Chaprashikov, although not well known in Bulgaria anymore, has been one of the most important figures of Bulgaria in the Olympic movement to this day. He was one of the four distinguished figures in the IOC, who were supporting the IOC president Count Henri de Baillet Latour.

Diem's concrete task was "to elaborate a general plan for physical education in schools and clubs" based on the "Law on the Physical Education of Bulgarian Youth" (ЗФВБМ – ZFVBM), which had been in force since 1931, and the "to determine the application of this law in Bulgaria". The latter certainly led him to conclude that "the law is essentially not implemented."[19]

His students f rom the German Higher School of Physical Education included: Borislav Yordanov, Georgi Karaivanov, Mladen Filipov, and Krum Katsarov. All of these were to provide him with direct and permanent assistance in the preparation and organization of his mission.

Over a period of about two and a half months in the autumn of 1937 Diem developed an "Organisational Plan for Physical Education in Bulgaria".[20] This work was published the same year in Sofia in the translation of M. Filipov and B. Yordanov, at that time inspectors at the Ministry of Public Education. (Uchilishten pregled, 1938). After this initial visit, Diem traveled to Sofia three more times (in 1939, 1940, and 1942).[21] While in 1940 he wrote in his diary that his "plan […] is still very far away" (CuLDA, 2009, pp. 1635), two years later he had already noted his conversation with Karaivanov on 23 March 1942:

"The Law on the Higher School […] has been promulgated. Four-years term of study. Sports gymnastics as a main discipline, in addition to an academic discipline. Four professorial chairs: Medicine, Pedagogy and two practical departments, in addition to it extraordinary academic and practical training. By April all will be set out in the law. Karaivanov hopes to acquire a department and a directorship. Yordanov is excluded because he is married to a Jewish woman (owner of a manicure parlour)." (Ibd., pp. 1730)

The plan launched by Diem in November 1937 coincided with a phase of Bulgarian educational policy, in which there was university or tertiary training for future teachers with academic aspirations for the majority of school subjects, but not for gymnastics and physical education or its teaching staff.[22]

Diem wrote about this:

"The older gymnastics teachers are trained in courses of Yunak gymnastics association; some younger teachers have been abroad at various institutions. As a result, I was told that the gymnastics teachers trained at the Czech

19 The reasons for this are manifold. First and foremost, Bulgaria's deep economic, financial and social crisis , which lasted well into the 1930s, is partly responsible for the failure of the law.

20 Diem stayed in Bulgaria from 15.09. to 30.11.1937. He undertook a series of trips around the country, at the end of which in addition to the „Organizational Plan", he published a long article in „Zora" newspaper, gave a speech on the radio and a report at the Royal Cinema prior to the screening of Leni Riefenstahl's film about the Olympic Games in Berlin. See also Zlatarski, ibd., p. 323

21 The other two trips in 1943 and 1944 were merely transits without substantial encounters or talks.

22 Diem, who considered himself a „sportsman" throughout his life, makes no consistent or comprehensible distinction in his organisational plan between „education in gymnastics", „education in sports" and „instruction within the framework of physical education".

University in Prague were the very worst, only slightly better were the results at the Higher School of Physical Education in Warsaw, whereas they were satisfied with the four-year training at the Royal Hungarian Higher School in Budapest. .... The education gained there is modern and thorough. The Bulgarians have entrusted leading positions only to teachers who were educated at the German College of Physical Education; these teachers hold the 4-6-month gymnastics teacher courses run by the Ministry of Education. Accordingly, the younger gymnastics teachers have a modern orientation and give brisk, natural gymnastics lessons. Here again, this is impaired by the community education at progymnasia, where the gymnastics lessons are mostly geared to the physically weak girls." (CuLDA, 2009)

This "Organizational Plan" was the first of its kind in Bulgaria, establishing state-oriented sports policy and governmental progress, where also was included and defined the framework for science-based, academic training of teachers of sports. It became crucial for the establishment and structure of the State Higher School of Physical Education in Sofia, the future National Sports Academy.[23]

In January 1944, immediately after the bombardment of Sofia, Diem last traveled through Bulgaria on his way back from Istanbul to Berlin, without however contacting the local sports officials.

After World War II, Diem's name was erased in the countries previously associated with the German Reich or in which Nazi-led politics had an impact and were now occupied by the Soviet Union. His work and publications were placed on the "black list" and thus consigned to oblivion or prohibition.

Thus, unlike before 1944, when his work and his visits to Bulgaria were largely reported on by the local press, there is evidence only of a very small number of publications related to Carl Diem in Bulgaria. The quality and quantity of references to Carl Diem himself and of his activities in Bulgaria in the form of written testimonies, notes, articles in the press, bilateral intergovernmental communication, etc. is relatively limited.[24] Indeed, before the changes in 1989/90, the German official had been mentioned here and there in the academic sports literature, but only tangentially in the context of the general political situation, under the strong influence of ideology, and almost exclusively negatively. This was because he was perceived as a representative of a system "hostile" to the communist worldview.

After the end of the 1980s, Carl Diem once again came into the spotlight of Bulgarian academic research in the history of sport. Authors worthy of particular mention are: R. Bardareva, Lozan Mitev and in recent times E. Vitanova (Bardareva, 2002, Mitev, 1996b, Vitanova, 2016). However, there is still no evidence of a single publication explicitly dedicated, and much less exclusively, to the work of Carl Diem as a central theme. The academics mentioned above refer to Diem more "among oth-

23 Lozan Mitev (2002) was one of the first to mention Diem's plan in the newer Bulgarian scientific literature. In his dissertation he presented a number of aspects of its more significant aspects.

24 Nevertheless, throughout his life, Diem himself was very keen to collect evidence of his activities at home and abroad. In addition to the „Tagebücher" (diaries) cited here from the „Sachakten" (subject files) of the CuLDA (folders 508 to 510), further evidence can be found in folders 806 and 81 1. A study of these as well as of the „organisational plan" in particular is reserved for a further study.

ers", and mainly in the context or in terms of other topics, e.g. the history of the National Higher Sports School, the Olympic Games in general, the International Olympic Academy, or the Olympic Movement in Bulgaria.

Moreover, his work in Bulgaria is not of a purely sports or pedagogical nature, but also pervaded by a political dimension, since the proposals for reform set out in his "Organizational Plan" of 1937 also sought to unify and involve all sports organizations along the lines of the prevalent German "Nationalsozialistischer Reichsbund für Leibesübungen" under the leadership of Reichssportführer Hans von Tschammer und Osten. This provoked a strong resistance from the independent Bulgarian sports organizations which had hitherto existed, such as The Bulgarian National Sports Federation (BNSF), which was subordinate to the Bulgarian youth organization "Brannik", comparable to the "Hitler Youth". In accordance with the political situation, Brannik was forced to unite into a common sports organization with the Union of Bulgarian Gymnastics Societies "Yunak" in order to enhance control by the state. In 1944, when the Communists came to power, this forced unification was dissolved. (Mitev, 1996b)

CONCLUSION

Notwithstanding the appearance of other sports officials at that time and given the general dynamic development of sports and the associated enthusiasm, Carl Diem had a particular importance for sport in Germany in the 20th century, above all in terms of:

- organization:
- training and methodology
- Olympic philosophy and education
- Sports politics and society

Furthermore, his international contributions to the Olympic idea are undeniable. He saw himself as a friend of Pierre de Coubertin, whom he met for the first time in 1909 and then on many other occasions until 1937, as his follower and guardian of his Olympic ideals. (Lennartz, 2000). The XI Olympic Games in 1936 and their success, as well as his commitments to sport in the country and abroad in general and the Olympic movement in particular, put him on a par with Coubertin, Baillet-Latour, Edström, and Brundage.

Carl Diem is indisputably important for Bulgaria and Bulgarian sport. The fact that in Germany Carl Diem has gradually become consigned to oblivion, and that correspondingly in recent decades, any assessment of his work has increasingly become limited to his political ideas, actions, and work, should not be deemed an obstacle to his achievements for Bulgarian sport being judged on merit.

For the above reasons, there have been no satisfactory or comprehensive research work on Carl Diem here in the country so far. There are still much material awaiting discovery and analysis. Such a work of academic analysis will not be limited to examining the "Organizational Plan" relevant to the training of Bulgarian sport teachers and the organization of sport in the country, but will also take into account the social and political circumstances and conditions, the general spirit of time and the reception of his proposals.

Although, in principle, the "Diem Debate" may seem appropriate for historiography, this debate cannot and should not be imposed on the Bulgarian context. First of all, the most extensive possible study of his work and his contribution to sport in Bulgaria will have to be carried out.

It is a fact that his "Organizational Plan"

marks the beginning of the establishment of the first (and only) Bulgarian Sports University, which in 2022 will celebrate its eightieth anniversary. This seems like the right time for the contribution of the German sport to be properly honored.

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Corresponding author:

Jörg Schenk
Department „History and Management of sport"
National Sports Academy „Vassil Levski"
21, Acad. Stefan Mladenov Str.
Sofia 1700, Bulgaria
E-mail: levski@web.de

AUTHOR'S GUIDELINES

GENERAL INFORMATION

Journal of Applied Sports Sciences accepts for review articles (original articles, reports, discussions, studies, editorial materials) in any of the following research areas: sport, sports excellence, sport medicine, sports physiology, biomechanics, nutrition, sports education, sports psychology, sports management and sports training, applied health and medical sciences related to the sports practices, social dimensions of sport and European dimensions in organizing modern sport.

The volume of the articles should not exceed 20 standard pages. Publications in Journal of Applied Sports Sciences should be written in English language.

Submissions to Journal of Applied Sports Sciences are made using ScholarOne Manuscripts, the online submission and peer review system. The registration and the access are available directly at https://mc04.manuscriptcentral.com/jasportssciences.

Full information and guidance on using Scholar One Manuscripts is available at the Emerald ScholarOne Manuscripts Support Centre: http://mchelp.manuscriptcentral.com/gethelpnow/training/author/.

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If you have not yet registered on ScholarOne Manuscripts, please follow the instructions below:

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- If you are going to create an account, please follow the on-screen instructions, filling in the requested details before proceeding
- Your username will be your email address and you must input a password of at least 8 characters in length and containing two or more numbers
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MANUSCRIPT SUBMISSION PROCESS

The proposed papers are submitted to the Editorial Board of the Journal of Applied Sports Sciences. Article submissions should be only made through electronic submission module on. To submit a paper for publication in the journal, the submitting author should log in the ScholarOne Manuscripts platform. We kindly request authors to carefully read Instructions & Forms before submitting their articles for review. Once logged in, the author can see a chronology of submitted manuscripts and send a new one through **"Start New Submission" => "Begin Submission".** The process of sending a new manuscript includes 7 basic steps:

Step 1: Select type of the manuscript, fill in the title and abstract in English language.

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Step 3: Attributes. Write and/or choose keywords. (The number of the keywords should not exceed 5 words).

Step 4: Authors & Institutions. Enter your co-authors' information by searching on each of their email addresses below. If they have an existing account, their information can be easily imported to the submission. If necessary, you may add a co-author as a new user in the system by clicking „Create New Author".

Step 5: Reviewers. To suggests a reviewer or request the exclusion of a reviewer, click the Add Reviewer button below and enter their information along with the desired designation.

Step 6: Details and Comments: The submitting author may enter or paste a cover letter text into the „Cover Letter“ box. The cover letter may also be attached. Answer any remaining questions appropriately.
Step 7: Review & Submit. Review the information below for accuracy and make changes as needed. After reviewing the manuscript proofs at the foot of this page, you MUST CLICK “SUBMIT” to complete your submission.

The received manuscripts are reviewed in accordance with Author’s Guidelines by a member of the Editorial Team. Manuscripts that do not comply with the requirements shall be returned to the authors for revision. Manuscripts that meet the requirements shall be admitted for review.

For each of the submitted and approved articles the Editor-in-Chief shall assign minimum two reviewers. Reviews shall be made in terms defined by the Editorial Board and in accordance with its requirements to the reviewers.

Reviewing of articles shall be done in accordance with the standards for the evaluation of manuscripts through the double-blind peer review system. The reviewers give their assessment of the manuscripts in terms of the following criteria: scope of the research, novelty of the examined issues, originality, accuracy and clarity of the abstract describing the main text, logic structure and sequence of the submission, relevance of the methodology, validity of the results, proving the thesis, applicability of the results, validity of findings and conclusions, propriety and relevance of citations, accuracy and clarity of language.

The Editor-in-Chief commits the final decision for publication, based on the conclusions of the reviewers. The decision can be: publish it without revisions, publish it after revision in accordance with the recommendations made in reviews, refuse to publish. If the Editor-in-Chief commits a decision to publish the manuscript after revision upon recommendations, authors should review and answer to the Editorial e-mails. The authors have to revise their manuscripts and present a report of the revisions they made in terms defined by the Editor-in- Chief, upon which a decision whether to publish it or refuse to publish the manuscript will be made. If there are contradictions of the reviews, the Editor-in-Chief may determine an additional reviewer (reviewers).

SUBMISSION AND STRUCTURE REQUIREMENTS OF THE ARTICLES

The article submissions shall be provided in Microsoft Word format, as follows:
Font: Times New Roman 12;
Format of the pages: Page Setup: Top: 2,5 cm, Bottom: 2,5 cm, Left: 2,5 cm, Right: 2,5 cm
Line Spacing: 1,5 lines; First Line: 1,5 cm; Paper Size: A4.
The main structure of the article shall include:
● First page; ● Introduction; ● Main text; ● Conclusions; ● References.

TITLE PAGE (PAGES)

The Title page/s includes:
Title of the article (it is recommended the title of the article be short (5-10 words) and present the main topic of the study);
Abstract. The abstract should be only in English language. It should be clear and concisely contain the following elements:

- Introduction (“background” of the study) (required);
- Purpose and objectives of the study (required);
- Applied methodology (“staging of the research”) (required);
- Achieved major results (required);
- Conclusions (required);
- Limitations of the research and consequences (if any).

The maximum length of the abstract should not exceed 300 words.
Keywords (specify up to 5 keywords in English).
Article Classification. Authors must categorize their paper as part of the ScholarOne submission process.

MAIN TEXT

Introduction

The purpose of the introduction is to convince readers that the published research contains novelty and it is applicable. It answers the following questions:

What is the main problem?

Are there any existing solutions (indicates the level of study the problem at the moment)?

What are the best solutions according to the author/s?

What is the main limitation of the research?

What is expected to be achieved by the author of the research?

The main text is structured into separate sections, distinguished by their titles (headings should be brief, with clear indication of the differences between their hierarchy). The preferred format for writing the main titles is to be bold format and subtitles to be written in italics. font – Times New Roman 12, capitals, left alignment).

The main text should include:

Purpose and objectives of the study. The purpose and objectives of the study should ensure the understanding of the publication's focus and should justify its structure. After that, authors should specify:

What is the significance of the publication?

Why the publication is important and original?

To whom is the publication designed?

Additionally, can be discussed potential utility of practice, importance for future studies, detailed limitations of the study and others.

Main thesis and hypothesis of the research. Authors' arguments about their merit are presented.

Applied methodology and methods. The author should indicate the main methods used by him in a separate title. Author should demonstrate that the methodology is robust and appropriate to achieve the objectives. It is expected by the author to focus on the main theme, to point the main stages of his research, to show the used methods and influences that determine the chosen approach by him, to give arguments why he has chosen specific extamples and others.

Achieved major results. When presenting the results, it is important that authors focus on the essentials. The publication must contain only the essential facts and those with a wider meaning, without giving many details of every possible statistics. If development is full of statistics, it is possible to prevail over the conclusions and after all the publication to be seen primarily as an enumeration of facts, not as a scientific study. The main thesis of the author must be clearly traceable and steadily established.

When describing the results author should seek answers to the following questions:

Do you provide interpretation for each of the submitted results you want?

Are the results consistent with what other researchers have found?

Are there any differences? Why?

Are there any limitations?

Does the discussion logically lead the reader to your conclusion?

It is important when presenting the results not to make statements that go beyond what results can acknowledge.

Conclusion

The general rule is that the conclusion should not only contain a summary of the research (it can be found in the abstract). The conclusion should give answers to the set at the beginning of the publication questions and to indicate opportunities for further research. It would be better to reveal how the achieved results will be applied in practice and to identify constraints in this regard. While indicating how this research can be applied and extended in future studies, it is not accepted in the conclusion to introduce new material or state the obvious. In the conclusion it should be emphasized what is different in the research results, what stands out in the design or is unexpected.

Notes

Notes or Endnotes should be used only if absolutely necessary and must be identified in the text by consecutive numbers, enclosed in square brackets and listed at the end of the article.

Funding agencies

The funding agencies of the scientific research should be added in Step 6 of the submission process on ScholarOne system.

Figures

All Figures (charts, diagrams, line drawings, web pages/screenshots, and photographic images) should be submitted in electronic form.

All Figures should be of high quality, legible and numbered consecutively with Arabic numerals. Graphics may be supplied in colour to facilitate their appearance on the online database.

- If possible, the figures should be made in graphical programs (Corel Draw, Adobe Illustrator, Adobe PhotoShop) or Excel. The figures should not be in Picture format. They should be numbered consecutively in order of citation in the text. Numbers and titles of the figures are placed below them. Authors should avoid many inscriptions inside the figures.
- Pictures and scanned images can be made into separate files, preferably in JPG or TIFF format, not embedded in the text. Photos must be of good quality and suitable for printing. Colour illustrations are accepted in exceptional cases after special agreement and eventual additional costs!
- If authors make a blueprint they should use Word Equation. The numbers of formulas should be written in brackets in the left side of the page!

Tables

Tables should be typed in Word Table or Excel format. They should be numbered consecutively according to citation in the text. Each table should have a title. Numbers and titles of the tables are placed over them. It is preferable that it fit on the page without turning widest part of the sheet horizontally. The necessary explanations are given below by means of appropriate symbols / characters.

Human and animal rights

In accordance with the Helsinki Declaration of 1975, as revised in 2000 and 2008, all authors should consider the following:

Manuscripts describing procedures involving humans or animals must include an explicit and easily identifiable statement pointing out that the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration. If any doubt exists as to whether the research was conducted in accordance with the Helsinki Declaration, the authors must, in primis, explain the rationale for their approach, and then demonstrate that the institutional ethical committee explicitly approved the doubtful aspects of the study. If the authors reporting experiments in which animals were included, authors must indicate that the institutional and national guidelines for the care and use of laboratory animals was followed.

The journal will not accept advertising for products or services known to be harmful to health (e.g. tobacco and alcohol products).

References

References to other publications must be in APA style and carefully checked for completeness, accuracy and consistency.

The cited authors should be presented in any of the following ways:

- Surname and year of publish (ex. Adams, 2006)
- Citing both names of two and year of publish (ex. Adams, Brown, 2006)
- When there are more than three authors, it is typed the surname of the first author and year of publish (ex. Adams et al., 2006)

At the end of the paper a reference list in alphabetical order should be supplied.

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