

A POSSIBLE RESEARCH METHOD OF IMPROVING PERFORMANCE CAPABLE KNOWLEDGE IN YOUTH BASKETBALL BY APPLYING COMPLEX SPORT CONDITIONING PROGRAM

NAGY BENEDEK ÁGOST¹

ABSTRACT. From the aspect of the energy management, today's basketball player profile can be divided to four resources: *physical, mental*, spiritual and emotional (Woods, Jordan, 2010). We intended to observe the physical and mental part of this system. In every age category the athletes must increase their current potentials and reach the master or expert level (Baracska, 2007). Our research supervised the special basketball demands and the implementations to a training program that could help us to get a correct picture what, when, whom, how, where and why to teach (Winter, 1997). We researched the game performances as the ingredients of competitiveness based on a research of BSMPG (2010) that broke down the game and gave us exact scientific data of the modern basketball game. **Purpose of study.** Evaluate of every scientific hypothesis. Observing a special conditional program that is used yearly for a men university basketball team. The main goal of our research is to analyse the common effects of these programs for the game performances of the players. Understanding the sports carrier profiles of the participants regarding to their game performances. We'd like to find the details of the improvement of the game performances with a new methods that will separate the team and individual parts of the training process. Our hope is that our results, findings will be useful for planning the basketball practices. We look for the answers which practice topics, drills, tests, types and methods are the most effective to increase the special game performance in this model. **Methods.** We looked for the answers to why and how questions with our descriptive research methods. We guaranteed the validity of our work to choose our model systemically. We followed a longitudinal and panel investigation to guarantee the proper tests data. The data were analyzed statistically with ANOVA, regression, T probe. We have also used some expert explanation from the gathered data. Hudl video analyzer program.

¹ University of Physical Education, Budapest, Hungary.
Corresponding Author: benji@basketclinic.hu

Results. The number of the high intensity sprint increases with the more ball possessions. (56/game, every 43-45 sec). The maximal vertical jumps of the players are predictable with the sum of the field goal attempts + blocks + rebounds (cc.10%). The defensive footwork is only 28 % of the playing time of a player. **Conclusions.** The longitudinal investigation was reasonable because the goals and the programs must be changed within the yearly practice plan. The teaching methods depends on the changes of the offensive strategy of the team. The more information we have about the physical and mental resources, the effective practice plan can be designed. A competitive conditional program can be properly designed that will consider the significant variants due to our findings. There is a significant connection between the performance of the practice program and the game performance.

Keywords: *conditioning, performance capable knowledge, physical resources, performance trend*

INTRODUCTION

From the aspect of the energy management, today's basketball player profile can be divided to four resources: *physical, mental, spiritual and emotional* (Woods, Jordan, 2010). We intended to observe the physical and mental part of this system. In every age category the athletes must increase their current potentials and reach the master or expert level (Baracscai, 2007).

We took the results of a BSMPG (2010) as a basis from the conditioning side, which describes the structure of modern basketball game with scientific figures.

Performance capable knowledge and competitive performance

Competitive performance is the aptitude of the athlete's ability to compete, that is, in a special and high state of excitement, consisting of two major components, both of which have a decisive role in action and performance.

- I. **Ability to perform** is a subfield that can be developed through training, can be learnt (through developing physical, coordination and other skills). The ability to perform is mainly an educational task, so its development is a constant goal of the trainer.
- II. By **capability to perform**, we mean the athlete's attitude towards requirements, their teammates, their coach, their emotional relationship to work, their revealing behavior. It can be developed but with lots of conflict in educational situations. It becomes a crucial factor at the higher level of preparation.

Scientific foundations

Our research is based on the scientific statistical results presented below. According to our findings, not only the research problem but the preparation itself should be based on these.

Theoretical bases of the conditioning program

Keith D'Amelio (2010) defines the structural features of the basketball game in his 2010 Boston research. These features were examined in case of the chosen team.

Basketball Game Breakdown.

Table 1. Basketball Game Breakdown. Own editing based on (BSMPG, 2010)

NBA — National Basketball Association, USA — Statistics
The average heart rate of male players during the game is 169 beats per minute. Plus-minus 9 beats per minute. McInne, Carlson, McKenna (1995)
There is a higher intensity sprint every 20 to 30 seconds. More than one hundred of these occur during a game.
In the NBA 2015/16 season, there were players, who ran an average of 4.41 kilometers in 67 games.
A maximum of 40-50 jumps per player.
There is a change of direction every 2-3 seconds.
30% of the time spent in the court is defensive footwork.
They play with close to maximum intensity 15% of the time.

HYPOTHESES

1. As the number of possessions increases, the number of high-intensity sprints increases as well, which thus occur every 20-30 seconds.
2. The combined value of certain scores in match statistics can be used to indicate the maximum number of jumps during the matches.
3. The team's time spent with defensive footwork is 30%.

OBJECTIVES

- Checking our hypotheses.
- Longitudinal understanding of college team's specific conditioning program and evaluating the combined effect of training work completed to competitive performance.
- Examining the participants' sports profiles with regards to competitive performance.
- Understanding the tendencies of the development of performance capable knowledge – competitive performance - at individual and team levels with a new approach.

We aimed to evaluate efficiency with the scientific understanding of the applied *conditioning programs* to make the results usable in practice. We have been researching which training materials, exercises, tests, training types and training methods are the most effective ways to improve performance in case of our sample.

RESOURCES AND METHODS

- We chose the method of *descriptive research*, where we aimed to answer the questions what and why through the exact measurement of different features. The **representativeness of the research within the team** was ensured by stratification and then by *systematic sampling*. The sample members were divided into two relatively homogeneous groups (layers) prior to sampling to reduce the possibility of errors. In our case, we found a more practical way than random sampling; the members of the two layers were placed in alphabetical order, numbered and then selected members x.
- By *cross-sectional and longitudinal analysis* of the sample's participants, data was collected at different times, which was also done on the whole sample. This way, we got a performance trendline, but we also made *panel surveys*, namely our observations were performed with the same people as well.
- We performed physical and conditioning tests in accordance with the pre-competitive period based on Brittanham (1996) and Foran & Pound (2007); their shooting performance was also characterized by general and per position measurements. Statistical data was made clear using our own tests and hudl.com/ reports.

We examined the trainers' programs that they have been using for years and asked their assistance to access to the exercises and tests of their conditioning programs. We provided feedback on our analyses on a week to week basis.

The content of measuring the ability to perform

NBA test exercises were used to measure the conditioning abilities (Foran, & Pound, 2007); on the one hand, because this is the highest-rated basketball in the world, and on the other, their professionals are at the forefront of the sport and scientific research related to the sport.

The number of maximum jumps based on the estimated and calculated individual results show significant similarities for the tested players.

Table 2. NBA conditioning tests and their shortcomings (Own editing)

Pre-test assessment	Additional information	Performance categories	Tests	Problems (K. D'Amelio)	Five plus tests
Height	Wearing shoes	Lower body strength	Vertical jump (from standstill) Vertical jump (from run-up)	It does not fully reflect the strength of the lower body.	- Hop and stop - One-legged squats
Height	Without shoes	Agility and explosiveness	Lane agility (Agility test around the penalty area)	Too much treading and defensive footwork that does not reflect the real needs of the game.	Modified Lane agility
Weight	Wearing shorts, half-naked and without shoes	Speed	3/4 court sprint	Too linear, it rarely happens in basketball without changing direction.	Illinois agility test Conrad (2014)
Touching height	Wearing shoes	Upper body strength	Bench press (maximum reps) University age group: 84kg High school age group: 61kg	It is not the most appropriate tool to predict NBA potential and upper body strength.	
Width		Flexibility	(Sit and reach)		
		Stamina			4x17 length (4x15m)

Conceptualization

We have selected the types of observations and measurements that meet the objectives of our research.

The measurement of performance capable knowledge was carried out by our own conditioning tests by doing the same tests with the layers at three different times.

The tests include: strength, maximum strength, speed, explosiveness/agility, flexibility, physical characteristics, balance, and hand-eye coordination measurement.

The tests started with a general survey (height, weight, etc.). These can be found in the first column (Table 2).

The third column contains the performance categories and associated tests, along with the five plus tests, which were suggested to be included in the program based on *Keith D'Amelio's (2010)* research.

The scientific literature has highlighted the following shortcomings, among others:

- Measuring vertical jump from a standstill; does it really measure lower body strength?
- Do the speed and directional changes used in lane agility tests (agility test around the penalty area) reflect the abilities used during basketball?
- With the $\frac{3}{4}$ court sprint, can we really measure the speed that the players reach during the transition from offense to defense?
- Does the bench press test really reflect the strength of the upper body?

Hudl video analysis program

The objective analysis of the matches was enabled by the HUDL video analysis and statistical program, which was also successfully used in case of conditioning program (Hudl 2017).

Conditioning tests

Tests and performance evaluation tools provided a comprehensive picture about the players; and about the speed, stamina, agility, endurance, explosive and flexibility programs.

The surveys are not only needed for individual development before, during and after the training programs, but also the resulting rankings can be used to motivate and encourage players to deliver their best possible performance (Foran &Pound 2007).

The measurement protocol

After a general, then sport-specific warm-up, performing the test exercises with the participants. The test was carried out by the athletes in the presence of the coaches. Only tests carried out with appropriate techniques and speed, as well as within the time limits were regarded as valid. There was no match or very demanding training on the test day or the day before.

Statistical methods

- To compare the average of groups with identical dispersion and normal distribution, we used the one-way ANOVA method.
- Relationships between variables were performed by regression analysis. We expected that we could predict the value of a dependent variable based on several independent variables.
- Differential analysis and probability variables were performed with paired- and two-sample T tests.

Analysis of the matches

At the start of the championship, with the knowledge of the opponents, the coaches made suggestions regarding the prospective main competitions. As a starting point, these matches were regarded as basis for the checks. The development of the championship helped us specify the list of supposed main competitions. These main competitions were well-defined in time.

The definition of main competitions:

- They were in the middle of the macrocycles.
- Another condition was to have close results.
- The position on the table.

RESULTS

Research results of the conditioning program

Based on the three measurements, except for the one-legged squats, progress can be detected for the players in the results of the fitness tests.

Within the tests, significant differences can be observed in the players' performance in the below cases.

In case of the lane agility tests, based on the two-sample t-test, the results of players #3 and #5 showed significantly less improvement than players #1, #2 and #4 ($t=3.092$, $p=0.037$).

In case of the mod. agility test the performance of player #1 shows a remarkable improvement compared to the other players ($t=3.033, p=0.039$).

For the analysis within the team, the two-sample t-test based on the number of training sessions does not show any significant differences. The results of the aforementioned lane agility show differences during the per position analysis.

Table 3. Results of the conditioning tests (Own editing)

		Lane ag. (second)	Mod. ag. (second)	Illinois test (second)	One-legged squat (centimeter)		3/4 court (second)
September	#1	11.32	2.85	15.25	15	16	3.28
	#2	11.82	3.02	15.36	32	36	3.31
	#3	11.92	2.99	15.38	16	22	3.38
	#4	12.14	2.95	15.81	80	80	3.37
	#5	12.56	3.25	15.9	70	75	3.52
May	#1	10.58	2.6	14.82	15	15	3.22
	#2	11.26	2.9	15.28	31	33	3.28
	#3	11.78	2.9	15.31	11	17	3.36
	#4	11.88	2.9	15.05	66	68	3.31
	#5	12.41	3.2	15.58	68	70	3.44
Difference	#1	0.74	0.25	0.43	0	-1	0.06
	#2	0.56	0.12	0.08	-1	-3	0.03
	#3	0.14	0.09	0.07	-5	-5	0.02
	#4	0.26	0.05	0.76	-14	-12	0.06
	#5	0.15	0.05	0.32	-2	-5	0.08

„There is a higher intensity sprint every 20 to 30 seconds, more than 100 of these occur during a match“

	Hop and stop (meter)		Vertical jump from run-up (centimeter)	Vertical jump from standstill (centimeter)	Sit and reach (centimeter)	Bench press (repetitions)	4x 17 (second)
September	2.13	2.17	82	56	14	1	59
	2.10	190	73	53	4	5	60
	2.27	2.13	91	57	6	24	62
	2	2.13	74	50	4	1	65
	2.01	1.99	70	50	-9	16	68
May	2.16	2.18	82	56	14	1	59
	2.17	201	80	54	4	6	60
	2.32	2.17	93	58	13	26	62
	2.04	2.15	74	50	5	1	61
	2.05	2.03	78	55	-6	20	68
Difference	0.03	0.01	0	0	0	0	0
	0.07	11	7	1	0	1	0
	0.05	0.04	2	1	7	2	0
	0.04	0.02	0	0	1	0	-4
	0.04	0.04	8	5	3	4	0

As the number of ball possessions and the number of points shot from fast break increased on a team level, the number of high-intensity sprints also increased per player in case of our sample. The team's season average is 55 high intensity sprints/match. An intense sprint occurred in every 43-45 seconds. (In the NBA it's 80 sprints/48 minutes/35-36second) The team had an average of 69 ball possessions.

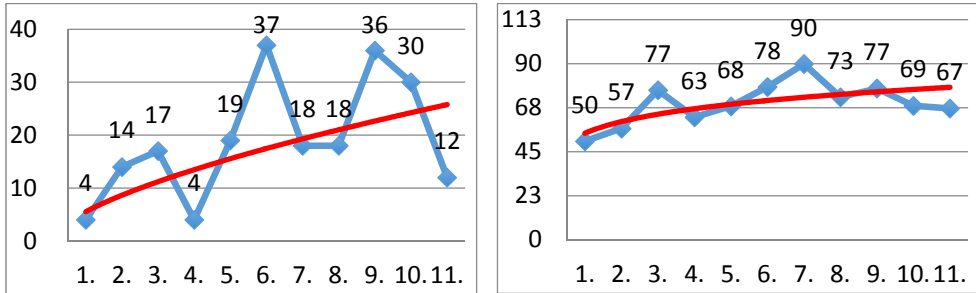


Figure 1. (Left side) Points from transitions (on team level) $X=Gamedays$ $Y= Points from transitions (on team level)$ (Right side) Number of ball possessions $X=Gamedays$ $Y= Number of ball possessions$ (Own editing)

Figure 1 based on the research and statistical results of the analysed 11 matches clearly shows that the trendline increasing simultaneously with the number of points shot from transitions and number of ball possessions.

Based on the observations, it can be seen per match that how many seconds pass on average between two high intensity sprints. The average scores of matches declined slightly towards the end of the season. The matches were closer.

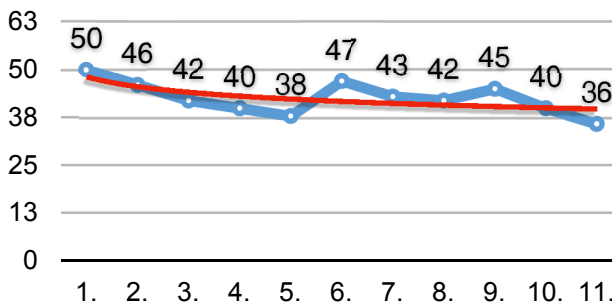


Figure 2. Time between sprints (in seconds) (Own editing)
 $X=Gamedays$ $Y= Time between sprints (in seconds)$

The connections were examined separately in case of the five players chosen during the research; these confirm the team level average values.

Table 4. The playing time of the players and number of sprints per match
(Own editing)

Match	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Avg.	
Minute Player #1	40	40	40	37	40	38	39	40	40	40	40	39.45	
Sprint	48	53	59	57	70	50	60	62	56	63	64		
Minute Player #2	37	36	40	32	40	34	38	40	36	40	40	37.55	
Sprint	52	52	63	53	66	53	58	63	54	61	70		
Minute Player #3	27	28	27	28	30	27	28	29	30	31	31	28.73	
Sprint	36	42	46	50	55	37	41	44	42	54	56		
Minute Player #4	15	15	13	14	0	14	14	0	16	13	14	11.64	
Sprint	8	10	11	10	0	8	9	0	9	11	12		
Minute Player #5	13	13	13	13	0	14	14	0	13	14	15	11.09	
Sprint	6	7	7	8	0	10	7	0	7	9	11		
Total: Minute	132	132	133	124	110	127	133	109	135	138	140		128.45
Total: Sprint	150	164	186	178	191	158	175	169	168	198	213		177.27
Seconds between sprints	53	48	43	42	35	48	46	39	48	42	39		43.85
Minutes total: 128.45	Total number of sprints: 180.36			Seconds between sprints: 43.13			High intensity sprints/match: 55						

„The maximum number of jumps during a match is 40-50”

Approximate number (+/-10% difference) from the statistics (rebound+shot+block).

The Hudl program allows counting the total and maximum number of jumps.

The goal on a team level is to increase the number of rebounds, blocks and field attempts.

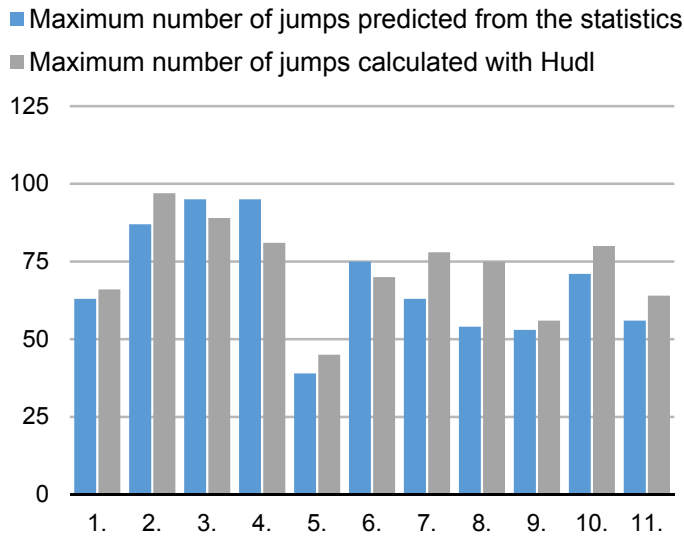


Figure 3. The total of maximum jumps of players 1 (calculated and estimated)
X=Gamedays Y=Number of jumps (Own editing)

The maximum number of jumps individually can be predicted from the statistics. For the five players, a difference of +/- 10% was detected per match. On a team level, the match statistics should be taken into account with caution as the errors can add up more significantly.

The number of maximum jumps based on the estimated and calculated individual results show significant similarities for the tested players.



Figure 4. The ratio of the number of jumps and the amount of time played per match (pcs/min) $X = \text{Gamedays}$ $Y = \text{Number of jumps}$ (Own editing)

„The players spend 30% of the time with defensive footwork”

We were able to measure the players' time spent with defensive footwork using the Hudl program.

On average, the team spends 31 minutes with defensive footwork on the court, which is 24% of the 128 average minutes.

Interestingly, player #1 spends 8,77 minutes with defensive footwork on the court. This is 22% of the 39.45 minute average match.

Players spend on average 24% of their playing time with defensive footwork. This is essentially true even if the playing time between players is significantly different.

Table 5. The correlation between playing time and time spent with defensive footwork (Own editing)

Player	Time spent on court in minutes (average)	Time spent with defensive footwork in minutes (total)	Time spent with defensive footwork in minutes (average)	Time spent with defensive footwork in percentage
#1	39.45	96.45	8.77	22%
#2	37.55	96.31	8.76	23%
#3	28.73	85.19	7.74	27%
#4	11.64	28.25	2.57	22%
#5	11.09	30.45	2.77	25%
Average	128			24%

The five players on average spend between 21.16% and 27.14% of their playing time with defensive footwork.

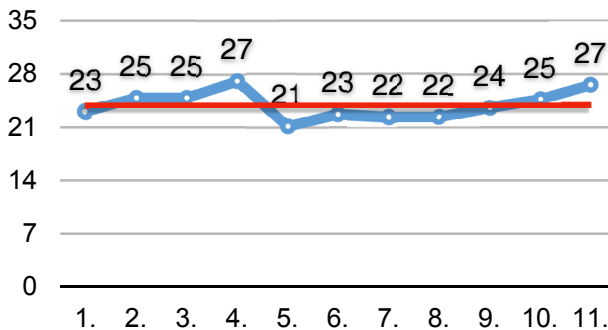


Figure 5. Percentage of time that was spent by defensive sliding (5 players)
X=Gamedays Y=ercentage of time that was spent by defensive sliding (Own editing)

The total number of time spent per match for the five players was between 117 and 130 minutes. At least 29 minutes were spent with defensive footwork; the longest time was 56 minutes.

Evaluation of match performance

In addition to analysis of the tests, we also examined the results of the matches (regression analysis). It can be stated that the explanatory power of the Value Point System (VPS) is strongly determined by the results of the tests, which is demonstrated by the R Square=0,894 value of the linear regression test.

Furthermore, we examined the results of some of the typical values of the matches (number of sprints, defensive footwork, jumps, field points, free throws, number of match points) (variance analysis (ANOVA)). Significant differences were observed between the players in case of each result ($t_{sp}=6.772$, $p=0.002$, $t_{vl}=22.883$, $p=0.000$; $t_{fjumps}=6.871$, $p=0.002$; $t_{sec}=11.556$, $p=0.000$; $t_{freethrow}=5.795$, $p=0.004$; $t_{mpoints}=6.156$, $p=0.004$). In our hypothesis, we assume that these results are affected by the number of training sessions attended.

It can be stated that from the match efficiency values based on the number of training sessions attended, only the number of sprints showed difference ($t=12.206$, $p=0.001$).

Thus it can be stated that the number of sprints during the matches (which is one of the determinants of the players' performance), can be significantly improved by increasing the attended training sessions as opposed to the other values. The analysis per position did not reveal any significant differences.

DISCUSSION

Hypotheses review

1. The number of the **high intensity sprint increases** with the more ball possessions. (56/game, every 43-45 sec)
2. The maximal **vertical jumps of the players are predictable** with the sum of the field goal attempts + blocks + rebounds (cc.10%)
3. The **defensive footwork** is only 24% of the playing time of a player.

It can be stated that the methods of education are related to the team's offensive strategy, the changes in individual abilities and the time available.

The more specific knowledge we have about *the physical and mental resources*; the more effective plan can be prepared.

A competitive conditioning program can be developed which takes into account the variables that are typical of the sample, since the partial results show a significant correlation between performance measured during the trainings and matches.

Conclusion

As the number of ball possessions and points shot from fast break increased on a team level, the number of high intensity sprints also increased per player in case of our sample.

There is a significant correlation between the amount of field attempts, rebounds and blocks and the result of video verification. (max.10% difference)

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