



THE IMPORTANCE OF PHYSICAL TRAINING IN BASKETBALL

Basketball as all Sports affects the human body through injuries, muscle overuse, illnesses, dehydration and other biomechanical strain.

It is highly recommended that a proper physical preparation is incorporated in the training of the basketball player.

This involves a program of conditioning exercises designed to develop muscle groups, improve cardiovascular capacity and physical performance, and to promote the safety and health of the players.

To understand the importance of physical training in basketball it is necessary to emphasize that high intensity activities, (over 70 % of VO₂max - which means that energy supplies are mainly from anaerobic sources CP, ATP and carbohydrates) such as basketball game, have energy cost of more than 4000 Kcal during game, and, while practicing even more (over 5000 Kcal depending on resting metabolic rate, age, sex and initial level of preparedness). Considering the number of rebounds (over 50), runs (over 100 which is over 2000 m), offensive and defensive actions, and contacts with the opponent it is obvious that the basketball game is far away from usual day life activity. To fulfill all of its demands it is necessary to improve physical abilities to optimal level. Following text and graphical presentations are tended to visualize the demands of basketball game from the physiological aspect (Table 1, Table 2) and to inform you about the average abilities of basketball players depending on age (Table 3), stature and body composition (Table 4). Data are collected at Research Laboratory of Faculty of Physical Culture in Belgrade on representative sample of more than 500 athletes. Table 3 and 4 present the results of some of the administered tests for motor abilities evaluation (Laboratory test battery consists of more than 30 test – motor abilities tests, cardio respiratory abilities tests, anthropometrics tests, psycho tests etc.)

Physiological aspects of basketball game

A discussion on importance of physical training in basketball game inevitably imposes the necessity of basic knowledge about physiological demands of game activity.

The analysis of basketball game from the aspect of physical training assume the analysis of:

Characteristics of physical activity

- **Nature of activity** (aerobic-anaerobic) energy supplies (ATP, CP, and glycogen...).
- **The intensity of activity** (average intensity, average heart rate, energy cost, oxygen deficit, rest intervals)
- and **work volume**



Method (training type)	Work intensity (m/sec.- %)	Heart rate (bits / min)	Work duration energy supplies	Heart rate before activity	Rest intervals Energy restoration
1	2	3	4	5	6
High and average intensity (subcompens) (I)	High (75-85%) Average (65-75%) 4-6 m/sec.	(175-185) (165-175)	5-50 min aerobic-anaerobic	(140-130)	Short pause (60-70%) energy restored
Submaximal intensity (compensation) (II)	(85-95%) 6-8 m/sec.	(185-195)	From 20-40 sec to 3-5 min. anaerobic-aerobic	(120-110)	Average pause (90-100%) energy restored
Maximal intensity (supercomp) (III)	(95-100%) 9-10 m/sec.	(190-220)	10-20 sec. Mainly anaerobic	(100-90)	Long pause More then 100% Energy restored
Low, moderate intensity (IV)	Low (30-50%) Moderate (50-60%) 2-2,5 m/sec.	Less then (150-165)	More then 50 min. Mainly aerobic	(80-70)	Very long pause Aprox. 100%
Variable intensity (V)	Variable (30-100%)	Depends on intensity	Aerobic – anaerobic	Resting heart rate	Excessively long pause 100%

Work	Short intervals I	Medium intervals II	Long intervals III	Very long intervals IV	Excessively long intervals V
Energy restored	(60-70%)	(90-100%)	(over 100%)	(aprox. 100%)	(aprox. 100%)
Heart rate	(140-130)	(120-110)	(100-90)	(80-70)	(Resting)

Table 1 and Table 2 depict relation between heart rate, energy supplies and recuperation period.



AGE	E Knee N	E Hip N	F Hip N	CMJ cm	CMJ h cm	Broad Jump Cm	FBE s	Sit-ups n	TapH N	TapL n	10x5m s	Reach Cm
8—9 AVG	13.24	48.8	15.2	19.1	22.52	137.60	21.7	26.89	8.73	11.7	23.36	16.40
10—11 AVG	16.57	45.4	13.7	23.9	28.38	176.83	22.1	32.47	7.49	9.72	20.68	19.00
12—13 AVG	21.55	56.5	16.2	30.4	36.99	191.42	23.6	46.66	6.40	9.76	19.38	19.00
14—15 AVG	25.07	63.9	17.1	31.8	39.42	217.88	25.5	50.15	5.78	9.22	18.58	23.12
16—17 AVG	25.54	66.7	17.9	35.5	43.94	232.21	25.9	54.08	5.28	8.77	17.73	26.39
Sen. AVG	29.02	72.4	20.8	37.5	45.10	243.59	27.3	58.01	4.97	8.66	17.78	24.82

Table 3 Average results of administered tests for evaluation of motor abilities

E knee – relatives' values (F isometric / BM ^{2/3}) of knee extensor force in Newton's purpose (strength evaluation)

E hip – relatives' values (F isometric / BM ^{2/3}) of hip extensor force in Newton's purpose (strength evaluation)

F knee – Relatives' values (F isometric / BM ^{2/3}) of hip flexors force in Newton's purpose (strength evaluation)

CMJ rebound height without arm swing in cm (Bosco method) (explosive power evaluation)

CMJh rebound height with arm swing in cm (Bosco method) (explosive power evaluation)

Broad jump – standing broad jump in cm (explosive power evaluation)

FBE (Fast body extensions) – No of test repetitions in 15 sec relatives to body height (No of repetitions * BH / 100) (coordination evaluation)

Test:

starting position: standing; on mark do the following:

- a) squat
- b) extend legs as fast as possible backwards, take the push – up position
- c) take the squat position again
- d) stand up – end of the test

Sit-ups No of sit-ups in 30 sec (repetitive strength evaluation)

Tap H 25 hand taping test (25 contacts) (segmental speed evaluation)

Tap L 25 leg taping test (25 contacts) (segmental speed evaluation)

10 x 5 m (running forward and backward 5 times) (agility evaluation)

Reach standing reaching test (flexibility evaluation)

AGE	BH(cm)	BW(kg)	% Osseous mass	%Muscle mass	%Depot fat	Muscle to fat ratio
11.00 AVG	160.70	55.17	19.80	45.73	23.80	2.01
13.00 AVG	170.80	53.38	21.13	45.98	15.48	3.51
14.00 AVG	181.64	64.76	21.22	48.34	11.95	4.32
15.00 AVG	190.79	72.60	20.16	49.48	11.30	4.71
16.00 AVG	186.46	74.94	18.85	49.78	11.75	4.60
17.00 AVG	195.13	81.00	18.48	51.23	11.27	4.82
>18 AVG	197.11	91.72	17.64	51.37	12.93	4.52

Table 4 Average results of anthropometrics tests for evaluation of stature.



To conduct a proper physical training it is necessary to make a periodization schema according to year period, sex, and age prospective period. On CD you will find software will introduce you to this problem (there are six different databases: FEMALE JUNIOR, FEMALE SENIOR, MALE JUNIOR, MALE SENIOR, LOOSING WEIGHT, GAINING WEIGHT). First four databases contain 6 months training periodization for basic muscle groups and exercises, periodization schema for preseason, season and first off season period.

SORTS OF TRAINING

Aerobic conditioning

Basic endurance conditioning improves general conditioning ability by strengthening heart as well as other cardio respiratory functions. This type of exercise is suitable for the beginners especially for weight management purposes. For more experienced exercisers it is a good alternative conditioning method. Aerobic conditioning improves cardio respiratory functions as well as general aerobic capacity. This type of exercise is safe and it is suitable also for the beginners.

Anaerobic conditioning

Conditioning at this intensity improves ability to utilize lactic acid. This makes it possible to exercise at high performance level for longer duration without oxygen dept. Conditioning at this intensity requires earlier exercise experience. Conditioning improves performance capacity needed in competitive situations.

Maximal conditioning

Exercise at maximal or near maximal intensities is anaerobic, which means that muscles need more oxygen than can be transferred. This type of conditioning is suitable only for the experienced exercisers. Conditioning improves maximal performance capacity.

Moderate activity

Daily activity at moderate intensity corresponds to the general physical activity during daily tasks. For the beginners and sedentary individuals daily activities improve readiness for the fitness-related exercise. For the experienced exercisers this type of activity can be used for recovery purposeste activity



STRETCHING

Stretching (front size-hamstrings)

Target muscles: abdominal, hip flexors, back extensors, hamstrings

Age group: all, recommendation - start with passive end with active stretching threw whole motion range, use 30 % of stretching time for PNF method*

Possible frequency: every day

Duration: 2 - 5min

Important notes: during stretching phase relax as much as possible, let your head fall down so you can both emphasize stretch and relax

Importance: hi - strong and flexible muscles upper - lower body coordination, flexible hamstrings lower risk of injury

*PNF method proprioceptive neuromuscular facilitation - simultaneous agonist stretching and antagonist contraction and vice-versa; example: while stretching triceps brachia contract biceps brachia

Stretching (front size-hamstrings-pair)

Target muscles: abdominal, hip flexors, back extensors, hamstrings, and laterals

Age group: all

Possible frequency: every day

Duration: 10 - 15 min

Important notes: during stretching phase relax as much as possible, let your head fall down so you can both emphasize stretch and relax

Importance: hi - strong and flexible muscles upper - lower body coordination, flexible hamstrings lower risk of injury

Stretching (front-back-side-quads)

Target muscles: abdominal, hip flexors, back extensors, hamstrings, and laterals

Age group: all

Possible frequency: every day

Duration: 10 - 15 min

Important notes: during stretching phase relax as much as possible, let your head fall down so you can both emphasize stretch and relax

Importance: hi - strong and flexible muscles upper - lower body coordination, flexible hamstrings lower risk of injury



Stretching (quads-hams)

Target muscles: abdominal, hip flexors, back extensors, hamstrings, and laterals

Age group: all

Possible frequency: every day

Duration: 10 - 15 min

Important notes: during stretching phase relax as much as possible, let your head fall down so you can both emphasize stretch and relax

Importance: hi - strong and flexible muscles upper - lower body coordination, flexible hamstrings lower risk of injury

Stretching (quads-hams-laterals)

Target muscles: abdominal, hip flexors, back extensors, hamstrings, and laterals

Age group: all

Possible frequency: every day

Duration: 10 - 15 min

Important notes: during stretching phase relax as much as possible, let your head fall down so you can both emphasize stretch and relax

Importance: hi - strong and flexible muscles upper - lower body coordination, flexible hamstrings lower risk of injury

Stretching (quads-hams-spine)

Target muscles: abdominal, hip flexors, back extensors, hamstrings, and laterals

Age group: all

Possible frequency: every day

Duration: 10 - 15 min

Important notes: during stretching phase relax as much as possible, let your head fall down so you can both emphasize stretch and relax

Importance: hi - strong and flexible muscles upper - lower body coordination, flexible hamstrings lower risk of injury



LOWER BODY EXERCISES

Abdominal leg rotations

Target muscles: abdominal, hip flexors, knee extensors

Age group: all

Possible frequency: every day

Importance: hi - strong abdominal muscles enable upper - lower body coordination

Hack squats

Target muscles: knee extensors (quadriceps)

Age group: all

Possible frequency: depends on intensity and work volume: 2 - 3 times per week

Important notes: keep feet at shoulder width 60 degrees divergent, keep air in lungs while pressing, exhale at the end of press

Importance: hi - 50 % of jump height depends on these muscles

Hamstrings leg curls

Target muscles: knee flexors (hamstrings, hip extensors)

Age group: all (recommendation - use it a lot with young selections, during preseason and off season)

Possible frequency: depends on intensity and work volume: 2 - 5 times per week

Important notes: avoid excessive separation of the body from the bench

Importance: hi - strong hamstrings enable power utilization of knee extensors

Pliometry squat

Target muscles: calves, knee extensors, knee extensors

Age group: all (recommendation - basic explosive type exercise for all categories, during preseason final position should be squat with prolonged deceleration phase, later on semi squat with short both deceleration (bob-down) and acceleration phase - (jump)

Possible frequency: dependant on intensity and work volume: 2 - 4 times per week

Important notes: ground contact should to be as short as possible, if not use broad jumps, number of jumps in set range from 5 - 10 depending on conditioning target, number of sets 2 - 5

Importance: hi - develops explosive power, coordination, rhythm, jumping endurance



Quadriceps

Target muscles: knee extensors (quads)

Age group: all (recommendation - use it a lot with young selections, during preseason and off season)

Possible frequency: depends on intensity and work volume: 2 - 4 times per week

Important notes: avoid excessive separation of the body from the bench

Importance: hi

Seated calf rises

Target muscles: calves

Age group: all

Possible frequency: every day

Importance: hi - calves contribute 20 % to vertical jump height

Side jumps

Target muscles: knee extensors, calves, back extensors, lateral muscles

Age group: all

Possible frequency: depends on intensity and work volume: 3 - 6 times per week

Purpose: coordination and jumping abilities development

Standing calf rises

Target muscles: calves

Age group: senior (recommendation - avoid using with young selections because of spinal loading)

Possible frequency: every day

Important notes: keep feet at shoulder width 60 degrees divergent, with lighter loads use it as stretching exercise too, number of repetitions range from 1 - 10 depending on conditioning target, number of sets 3 - 8

Importance: hi - calves contribute 20 % to vertical jump height

Squat jumps

Target muscles: calves, knee extensors, back extensors, ante flexors (front part of shoulders)

Age group: all (recommendation - basic preparatory explosive type exercise for all categories)

Possible frequency: dependant on intensity and work volume: 2 - 4 times per week

Important notes: ground contact should to be as short as possible, if not use broad jumps, number of jumps in set range from 5 - 10 depending on conditioning target,

number of sets 2 - 5

Importance: hi - develops explosive power, jumping endurance



UPPER BODY EXERCISES

Back extensors

Target muscles: back extensors, hip extensors

Age group: all

Possible frequency: every day

Importance: hi - back extensors and hip extensors contribute 20 % to vertical jump height

Bench press

Target muscles: pectorals, elbow extensors (triceps brachia), ante flexors

Age group: all

Possible frequency: depends on intensity and work volume: 2 - 4 times per week

Important notes: keep elbows aside, aligned to chest middle line, keep air in lungs while pressing, exhale at the end of press

Importance: depends on player position centers need it more

Biceps curl

Target muscles: elbow flexors

Age group: > 16

Possible frequency: depends on intensity and work volume: 2 - 4 times per week

Important notes: avoid bending, keep back straight, rotate wrist toward chests at the end of the movement

Importance: lo

Biceps standing barbell curls

Target muscles: elbow flexors

Age group: > 16

Possible frequency: depends on intensity and work volume: 2 - 4 times per week

Important notes: avoid bending, keep back straight, rotate wrist toward chests at the end of the movement

Importance: lo

Abdominal Vs

Target muscles: abdominal, hip flexors, knee extensors

Age group: all

Possible frequency: every day

Important notes: lordotic children should use it with precaution

Importance: hi - strong abdominal muscles enable upper - lower body coordination



Sit-ups

Target muscles: abdominal, hip flexors, knee extensors

Age group: all

Possible frequency: every day

Importance: hi - strong abdominal muscles enable upper - lower body coordination

Sit-ups-stretching

Target muscles: abdominal, hip flexors, knee extensors

Age group: all

Possible frequency: every day

Important notes: during stretching phase relax as much as possible, let your knees touch the ground

Importance: hi - strong abdominal muscles enable upper - lower body coordination, flexible hamstrings
lower risk of injury

Upright rows

Target muscles: shoulders (mm. deltoid, m. trapezius)

Age group: senior (recommendation - avoid using with young selections because of spinal loading)

Possible frequency: every day

Important notes: keep feet at shoulder width, keep elbows high, number of repetitions range from 1 - 10
depending on conditioning target,

number of sets 3 - 8

Importance: medium



WHOLE BODY EXERCISES

Accentuated calves jumps

Target muscles: calves, knee extensors, back extensors

Age group: all

Possible frequency: depends on intensity and work volume: 3 - 6 times per week

Importance: hi - calves contribute 20 % to vertical jump height

Agility complex

Target muscles: abdominal, knee extensors, calves, back extensors

Age group: all

Possible frequency: depends on intensity and work volume: 3 - 6 times per week

Purpose: coordination and jumping abilities development

Agility side jumps

Target muscles: abdominal, knee extensors, calves, back extensors, lateral muscles

Age group: all

Possible frequency: depends on intensity and work volume: 3 - 6 times per week

Purpose: coordination and jumping abilities development

Hurdle jumps

Target muscles: calves, knee extensors, back extensors, ante flexors (front part of shoulders)

Age group: all (recommendation - basic explosive type exercise for all categories)

Possible frequency: dependant on intensity and work volume: 2 - 4 times per week

Important notes: ground contact should to be as short as possible, if not use broad jumps, number of jumps in set range from 5 - 10 depending on conditioning target, number of sets 2 - 10

Importance: hi - develops explosive power, coordination, rhythm, jumping endurance

Rope jumping

Target muscles: calves, knee extensors, ante flexors (front part of shoulders)

Age group: all (recommendation - basic endurance type exercise for all categories)

Possible frequency: every day

Important notes: ground contact should to be as short as possible, duration up to 15 min.

Importance: hi- develops explosive power, coordination, rhythm, jumping endurance