PEAK EXPIRATORY FLOW RATE OF BASKETBALLERS: CORRELATION WITH ANTHROPOMETRIC MEASUREMENTS, BIOCHEMICAL PARAMETERS AND AEROBIC WORK CAPACITY

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Abstract:

Air pollution caused by waste disposal is on increasing. Children & adolescents are more prone to the exposure as they spend their maximum time in outdoor activities. Young players engaged in the field practice in the outdoor games like basketball can experience difficulties in reaching at the peak of aerobic power because of low peak expiratory flow rate (PEFR). Present study deals with measurement of PEFR of forty (n=40) female & male basketball players from age groups 10-12 & 13-15 yrs. Respiratory rate (RR) & hemoglobin level (Hb) of players were measured. Weight, height & wrist circumference were measured & based on these indices, body mass index (BMI), body surface area (BSA) & body frame size (BFS) were derived. Mean PEFR of boys from both the age groups of 10-12 & 13-15 yrs was higher than girls of same age. Positive effect of sports training on PEFR in girls & boys from age group 13-15 yrs was seen, with PEFR correlated positively with age. PEFR also correlated positively with RR, Hb & VO_2max.

Keywords: *peak expiratory flow, VO_2max, respiratory rate, body surface area.*

Introduction:

The developing tendencies in international sports, especially in team games are identified as the increase in game tempo, tougher body game & greater variability in technique & tactics. An increased performance level can only be achieved by working & training of all major components i.e. coordination, physical fitness, physiological qualities & psychological qualities. Basketball is one of the most popular team based sports played & watched throughout the world. For optimal performance during play at an elite level, a variety of areas must be addressed. These include the high skill level, flexibility, muscular strength, speed, agility & importantly the specific use of different physiological, body composition, psychomotor variables & aerobic capacity (Singh & Deol, 2012).

Aerobic exercise is an important component of pulmonary rehabilitation which is defined as "any activity that uses large muscle groups, can be maintained continuously, & is rhythmic in nature". It is a type of exercise that overloads the heart as well as lungs & causes them to work harder than at rest.

Competitive sports represent most extreme stress to which the body can be exposed. Physical ability of an athlete's body is determined by the quality of external breathing & cardiovascular functions & by features of metabolism related to the tissue breathing & transport of substrates. There exist many models of human physical activity, with their specificity determined by the relevant kind of sport & inherent features of the individual as well as by time & geographic factors. In today's life, young athletes including basketball players are exposed to environmental pollution – on the court & off the court. This atmospheric exposure to variety of pollutants affects the lung capacity of players which then influence aerobic endurance & performance.

Peak expiratory flow rate (PEFR) is the maximal expiratory flow rate achieved & it measures how fast a person can breathe out (exhale) air. It is one of many tests that measure how well your airways work. It is a simple method of measuring airway obstruction & it detects moderate or severe lung disease (Chaitra & Vijay, 2011).

The aim of this study was to evaluate the PEFR & its effect on anthropometric measurements, biochemical parameters & aerobic work capacity of basketball players from 10-15 years of age.

Methodology:

Present study deals with correlation of PEFR with body measurements, biochemical parameters & aerobic work capacity of basketball players.

Study Area & Sample Selection: Total 40 young female & male basketball players from 10-15 years of age were selected from well-known basketball training clubs & institutes in Nagpur, Maharashtra. Table I shows age wise distribution of subjects.

PEFR Measurement: PEFR was measured using JSB peak flow meter. Each player was asked to take a deep breath & then blow into peak flow meter as hard as he can by placing the lips tightly on the mouth piece. The values were then noted as the pointer moved up the scale. The procedure was repeated thrice for every player. Peak flow readings of subjects were classified into 3 zones of measurement (http://www.lung.org/lung-disease/asthma/living-with-asthma/take-control-of-your-asthma/measuring-your-peak-flow-rate.html).

Anthropometric Measurements: Anthropometric measurements like height & weight of subjects were measured using standard procedures & equipments. Measurements were compared with reference standards (National Nutrition Monitoring Bureau/NIN/ICMR, 2002 & India Nutrition Profile, 1998). Body mass index (BMI), body frame size (BFS) & body surface area (BSA) were also derived.

Respiratory Rate: Respiratory rate (RR) of players was recorded as cycles per minute & evaluated on the basis of reference range given by Marx et al. (2002).

Hemoglobin Level: It was evaluated by referring classification of degree of anemia based on hemoglobin level WHO/ UNICEF/UNU, (2001).

Physical Fitness: Aerobic fitness of basketballers was evaluated using Cooper's VO_2max test [12 minute's run walk test].

Statistical Analysis: Data was gathered, tabulated & grouped. Mean, standard deviation, minimum, maximum & percentage values were calculated. Pearson's product moment coefficient of correlation was used to correlate various parameters. The significance of difference was tested at both 0.01 & 0.05 levels of significance.

Results & Discussion:

Data on PEFR of basketball players in Table II suggests that mean PEFR of boys from both the age groups of 10-12 yrs & 13-15 yrs was higher than that of the girls. Irrespective of age & gender, minimum PEFR was 143.33 L/minute & 520 L/minute was the maximum value. As per the classification of PEFR, for the present study, 100% subjects were under

"green" zone (80-100 % of the usual or normal peak flow readings) which indicates that the lungs are in good condition & case is under good control.

PEFR showed negative correlation with age among girls & boys from age group 10-12 yrs (r= -0.27 & -0.40, respectively). With increasing age PEFR of these players was reduced which might be due to more exposure to the air pollution. However, positive effect of sports training on PEFR in girls & boys from age group 13-15 yrs was seen, with PEFR correlated positively with age (r=0.27 & 0.72, respectively).

With the exception of boys from age group 10-12 yrs, PEFR among girls from age groups 10-12 & 13-15 yrs & among boys from age group 13-15 yrs, correlated positively with weight. It is postulated that greater the fat free mass higher the muscular power which enables better oxygen delivery to body cells. PEFR showed positive correlation with hemoglobin level (r=0.09 for girls-10-12 yrs; r=0.03 for girls-13-15 yrs & r=0.56 for boys-13-15 yrs).

With the exception of girls from age group 13-15 yrs, PEFR showed positive correlation with RR among girls (10-12 yrs) & boys (10-12 & 13-15 yrs). PEFR showed positive correlation with VO_2max among girls from both age groups (r=0.18 & 0.19, respectively for 10-12 & 13-15 yrs) & among boys from age group 13-15 yrs (r=0.55).

Height for all the players was found to be lesser than the standard values given by ICMR. % deficit was calculated as 8.93, 2.31, 5.57 & 10.49 for girls aged 10-12 yrs & 13-15 yrs & boys aged 10-12 yrs & 13-15 yrs, respectively (Table III). Older girls were taller than older boys & the difference in their mean height was calculated as 7.8 cm.

Subjects were unable to meet the standards for weight, with % deficit calculated as 1.43, 3.97, 12.25 & 19.75 %, respectively for girls aged 10-12 yrs & 13-15 yrs & boys aged 10-12 yrs & 13-15 yrs, respectively. It was notable that the girls of both the age groups were heavier than the boys from the same age groups with a difference of 4.4 & 6.55 kg, respectively between their mean values. Age was found to be negatively correlated with weight (r= -0.11 to -0.29, respectively) among girls from age groups 10-12 & 13-15 yrs.

In contrast to this, among boys from age groups 10-12 & 13-15 yrs, age correlated positively with weight (r=0.04-0.12, respectively).

Girls from both age groups showed higher mean BMI values as compared to standard values for age. In contrast, boys had lower mean values of BMI as compared to standard values for age. For girls & boys from both age groups, age correlated positively with BMI.

BSA was found to be higher for girls of both age groups than that of boys having range depicted as 0.82 to 1.49 for all players. Older girls were found to be taller than boys whereas girls from both age groups were found to be heavier than boys. Greater is the BSA higher is the requirement of oxygen by the body & harder the work lungs & heart need to do. Among girls from age groups 10-12 & 13-15 yrs, age correlated negatively with BSA (r= -0.05 & -0.28, respectively). Whereas among boys from age groups 10-12 & 13-15 yrs, age reflected positive correlation with BSA (r=0.11 & 0.40, respectively).

BFS of basketballers was calculated using wrist circumference & height. Minute difference in the mean values of wrist circumference of boys & girls of 13-15 yrs age group was noticed. Girls from age group 10-12 yrs had greater wrist circumference value than that of boys from same age group. Among younger girls & older boys, BFS correlated positively with BFS.

Using the equation & classification of Anderson et al. (1982), BFS of players was calculated. Greater the calculated value, lower the BSA & vice versa. Value >10.4 indicates smaller BFS; between 9.6-10.4 indicates medium BFS & <9.6 indicates large BFS. For the present study, the mean value of BFS for girls of age group 13-15 yrs was more than that of boys from same age group, indicating that girls were having smaller BFS than boys. In contrast to this, it was lesser in girls of 10-12 yrs age group than that of boys.

Hemoglobin level of all the subjects was above 11g/dL (Table IV). However as per classification given by WHO/UNICEF/UNU (2001), 20% boys & 20% girls from age group13-15 yrs had mild anemia; 30% were moderately anemic & 50 % were non-anemic. Whereas in girls from 10-12

yrs age group, 10% had mild anemia & 30% had moderate anemia. 30% boys from age group 10-12 yrs were mildly anemic & 40% were moderately anemic.

RR seemed to be much higher than the reference range given by Marx et al. (2002) (for 6-12 yrs, RR should be 18-30 breaths/minute & for >12 yrs, RR should be 12-16 breaths/minute). Higher the respiratory rate harder the heart is working. Boys were fitter than girls with lower mean values of respiratory rate as also clear from Table IV. By practice & regular aerobic training, deep controlled breathing techniques can be acquired. RR correlated negatively with weight. Greater the weight the harder effects lungs have to make.

RR found to be correlated negatively with age among girls from age group 13-15 & boys from age groups 10-12 & 13-15 yrs. These results indicate that with the age there found decrease in RR which could be attributed to regular sports training & aerobic endurance. Among these basketballers, age correlated positively with VO2max indicating that sports training on regular basis increase aerobic capacity.

Aerobic work capacity of players was tested by 12 minute run walk field test (Table V). It was noticed that younger boys performed well than girls of same age (10-12 yrs). In contrast to this, older girls (13-15 yrs) performed better than boys of same age. Both girls & boys from age group 13-15 yrs were rated "excellent" as mean distance covered by them was >2077 meters. Girls & boys from age group 10-12 yrs were rated "above average".

These findings indicate that PEFR was positively influenced by age, respiratory rate, hemoglobin level, weight & sports training. Aerobic power of players was influenced by PEFR.

Table I: Age Wise Classification of Sample

Sr. No.	Age Group (Yrs)	Subjects (N = 40)	
		Girls (n = 20)	Boys (n = 20)
1	10 - 12	10	10
2	13 - 15	10	10

Table II: Data on PEFR of basketballers

Sr. No.	Parameters	Girls		Boys	
		Age Group 10-12 Yrs (n=10)	Age Group 13-15 Yrs (n=10)	Age Group 10-12 Yrs (n=10)	Age Group 13-15 Yrs (n=10)
I	Peak Expiratory Flow Rate (Liters/Minute)				
1	M±SD	248.33±45.28	223.67±48.55	265.33±54.83	336±101.19
2	Range	193.33-306.67	143.33-286.67	173.33-353.33	213.33-520

Table III: Data on Anthropometric Measurements of Basketballers

Sr. No.	Parameters	Girls		Boys	
		Age Group 10-12 Yrs (n=10)	Age Group 13-15 Yrs (n=10)	Age Group 10-12 Yrs (n=10)	Age Group 13-15 Yrs (n=10)
I	Height (cm)				
1	M±SD	132.2±6.11	152.9±6.74	137.2±4.54	145.1±7.45
2	Range	120-140	141-165	130-143	135-157
3	Standard	145.17	156.53	145.3	162.1
4	% Deficit	-8.93	-2.31	-5.57	-10.49
II	Weight (kg)				
1	M±SD	34.5±11.15	44.75±4.91	30.1±3.14	38.2±4.16
2	Range	20-50	37-50	24-35	32-44
3	Standard	35	46.6	34.3	47.6
4	% Deficit	-1.43	-3.97	-12.25	-19.75
III	Body Mass Index (BMI) (kg/m²)				
1	M±SD	19.40±4.97	19.15±1.83	15.97±1.27	18.27±2.74
2	Range	13.77-26.34	15.82-21.36	13.57-17.56	13.66-23.10
3	Standard	16.57	19	16.2	18.1
4	% Deficit/Excess	+17.08	+0.79	-1.42	-0.94
IV	Body Surface Area (BSA)				
1	M±SD	1.12±0.20	1.38±0.10	1.07±0.07	1.24±0.07
2	Range	0.82-1.39	1.20-1.49	0.94-1.18	1.11-1.37
V	Wrist Circumference (cm)				
1	M±SD	13.1±1.29	14.35±0.71	12.85±0.94	14.33±1.37
2	Range	11.5-15.5	13-15	11-14.5	13-17.5
VI	Body Frame Size (BFS)				
1	M±SD	10.15±0.72	10.67±0.62	10.71±0.58	10.20±1.00
2	Range	9.03-11.13	9.8-11.79	9.86-11.82	7.89-11.33

Table IV: Data on Biochemical Parameters of Basketballers

Sr. No.	Parameters	Girls		Boys	
		Age Group 10-12 Yrs (n=10)	Age Group 13-15 Yrs (n=10)	Age Group 10-12 Yrs (n=10)	Age Group 13-15 Yrs (n=10)
I	Hemoglobin Level (g/dL)				
1	M±SD	11.61±1.06	11.7±1.47	11.12±1.42	11.29±1.61
2	Range	10-12.8	9.2-13.4	9.1-13.2	9-13.2
II	Respiratory Rate (Cycles/Minutes)				
1	M±SD	40.3±14.66	38±18.81	37.8±9.15	34.6±13.85
2	Range	18-57	15-76	23-48	15-60

Table V: Data on Aerobic Work Capacity of Basketballers

Sr. No.	Parameters	Girls		Boys	
		Age Group 10-12 Yrs (n=10)	Age Group 13-15 Yrs (n=10)	Age Group 10-12 Yrs (n=10)	Age Group 13-15 Yrs (n=10)
I	Cooper's VO_2max Test (distance covered in meters)				
1	M±SD	1929.6±236.14	2313.6±353.15	2012.8±376.66	2262.4±301.34
2	Range	1568-2304	1920-3040	1280-2560	1824-2688

Table VI: Correlation Coefficient Values

Sr. No.	Parameters	Correlation Coefficient Values (r)			
		Girls		Boys	
		Age Group 10-12 Yrs	Age Group 13-15 Yrs	Age Group 10-12 Yrs	Age Group 13-15 Yrs
1	Age vs. Weight	-0.11	-0.29	0.04	0.12
2	Age vs. BMI	-0.18	-0.21	-0.16	-0.38
3	Age vs. BFS	0.35	-0.06	-0.30	0.36
4	Age vs. BSA	-0.05	-0.28	0.11	0.40
5	Age vs. RR	0.37	-0.53	-0.61	-0.18
6	Age vs. VO_2max Test	0.08	0.18	-0.06	0.25
7	Age vs. PEFR	-0.27	0.27	-0.40	0.72
9	Weight vs. RR	-0.31	-0.29	-0.08	-0.10
10	Weight vs. VO_2max Test	-0.51	-0.20	0.13	0.27
11	Weight vs. PEFR	0.11	0.11	-0.09	0.34
12	Hemoglobin vs. PEFR	0.09	0.03	-0.27	0.56
13	RR vs. PEFR	0.47	-0.13	0.42	-0.68
14	VO_2max Test vs. PEFR	0.18	0.19	-0.01	0.55

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