PEAK EXPIRATORY FLOW RATE OF HEALTHY PRESCHOOLERS: CORRELATION WITH ANTHROPOMETRIC MEASUREMENTS AND NUTRIENT INTAKE

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Abstract:

Peak expiratory flow rate (PEFR) is an important measure of lung function in obstructive airway diseases. The values of PEFR vary with age, sex and height. This study deals with the determination of PEFR values in healthy preschool children from 3-5 years of age of Nagpur city. Effect of factors like age, sex, anthropometric measurements & nutrient intake on PEFR was studied. Total 600 girls and boys from age groups 3+, 4+ & 5+ yrs were selected from well known kindergartens (KG) and anganwadis (AW) from Nagpur city. PEFR was measured using peak flow meter. Height & weight were recorded. Based on three day's dietary information, nutrient intake of subjects was calculated. 100% subjects were under "green" zone of flow meter reading (indication of good condition of lungs). Mean PEFR values ranged from 115.8±7.45 to 125.9±3.14 L/minute. Mean respiratory rate ranged from 31.10±1.09 to 32.38±1.29 cycles/minute. PEFR correlated positively with respiratory rate, height & weight. Majority groups of subjects had positive correlation of PEFR with intake of energy & energy yielding nutrients.

Keywords: *peak expiratory flow rate, nutrient intake, anthropometric measurements*

Introduction:

Outdoor air pollution is a major problem in developing countries especially India. The World Health Organisation (WHO) found that the air quality in large cities in many developing countries is remarkably poor and that very large numbers of people in those countries are exposed to ambient concentrations of air pollutants well above the WHO guidelines for air quality (www.who.int/ceh/publications/en/11airpollution.pdf).

The health effects of air pollution exposure have been an area of increasing focus in the past 30 years. A growing body of evidence has demonstrated that there are serious health consequences to community because of air pollution and that these consequences are not spread equally among the population. Children's exposure to air pollution is a special

concern because their immune system and lungs are not fully developed when exposure begins, raising the possibility of different responses than seen in adults. Children spend more time outdoors than adults, particularly in the summer and in the late afternoon. Some of that time is spent on activities that increase ventilation rates (Schwartz, J., 2004).

Bronchial asthma is a common entity in childhood respiratory illness. Peak expiratory flow rate (PEFR) is an important measure of lung function in obstructive airway diseases. The values of PEFR vary with ethnicity and geographical areas as well as age, sex and certain body measurements like height. PEFR recording is one among the many lung function test helpful in evaluation, monitoring, management and follow up of patients with bronchial asthma. PEFR is an accepted index of pulmonary function (Reddy, U. N. et al., 2014).

This study was undertaken with following objectives:

1. To determine the PEFR in healthy preschool children from 3-5 years of age of Nagpur city.
2. To study the effect of factors like age, sex, anthropometric measurements & nutrient intake on PEFR.

Methodology:

Present study deals with correlation of PEFR with physical measurement, dietary intake and respiratory rate of preschoolers.

Study Area and Sample Selection: For the present study, total 300 girls and boys from age groups 3+, 4+& 5+ yrs were selected from well known kindergartens (KG) and anganwadis (AW) from Nagpur city. Table I shows age wise classification of girls & boys.

Data Collection:

PEFR Measurement: PEFR was measured using JSB peak flow meter. Each child was told to take a deep breath and then flow into peak flow meter as hard and as fast as possible through mouth piece and was closely watched to ensure that he/she maintains an air tight seal between lungs and mouth piece of instrument. Disposable mouth piece were used for recording PEFR. The procedure was repeated thrice, highest value of these three readings was taken as observed PEFR.

Respiratory rate of subjects was also recorded as cycles per minute. Peak flow readings of subjects were classified into 3 zones of measurement (American Lung Association- http://www.lung.org/lung-disease/asthma/living-with-asthma/take-control-of-your-asthma/measuring-your-peak-flow-rate.html; http://www.webmd.com/asthma/guide/peak-flow-meter & http://www.mayoclinic.org/tests-procedures/peak-flow-meter/basics/definition/prc-20013057). Table II shows classification based on PEFR of subjects.

Anthropometric Measurements: Anthropometric measurements like height & weight of subjects were measured using standard procedures and equipments. Measurements were compared with reference standards (National Nutrition Monitoring Bureau/NIN/ICMR, 2002 & India Nutrition Profile, 1998)

Nutrient Intake: 24 hour's dietary recall method was used to collect three day's dietary recall of subjects. Based on this, nutritive values (energy & macro-nutrients) of diets of subjects were calculated using standard food value tables. Nutrient intake of subjects was compared with RDAs (National Institute of Nutrition (NIN)/Indian Council of Medical Research (ICMR), 2009).

Statistical Analysis: Data was collected and tabulated. Mean, standard deviation, minimum, maximum and percentage values were calculated. Pearson's product moment coefficient of correlation was used to correlate various parameters with PEFR.

Results & Discussion:

Data on mean PEFR of subjects classified age wise is demonstrated in Table III. Boys from KG aged 3+ yrs had higher mean PEFR than girls from AW aged 3+ yrs. In contrast to this, Boys from KG aged 3+ yrs had lower mean PEFR than girls from AW aged 3+ yrs. AW girls (3+ yrs) had higher mean PEFR than KG girls (3+ yrs) However, girls & boys from age groups 4+ & 5+ showed similar mean values of PEFR. Boys aged 3+, 4+ & 5+ yrs from KG presented higher PEFR values than boys aged 3+, 4+ & 5+ yrs from AW. Irrespective of age & gender, minimum PEFR was 110 L/minute &

maximum PEFR was 130 L/minute. Mohammadzadeh, I. I. et al. (2006) reported PEFR average in elementary students as 244.21± 59.56 L/minute. As per the classification of PEFR, for the present study, 100% subjects were under "green" zone which indicates that the lungs are in good condition & case is under good control.

Table IV shows data on anthropometric measurements of subjects. Results clearly depict that girls & boys from KG (age groups 3+, 4+ & 5+ yrs) were taller than girls & boys from AW (age groups 3+, 4+ & 5+ yrs). Girls & boys from KG (age groups 3+, 4+ & 5+ yrs) surpassed the standard reference values of height for age indicating influence of income level & nutritional habits on height. In contrast, mean values of height of girls & boys from AW (age groups 3+, 4+ & 5+ yrs) were found below the standard reference values of height for age. Height is genetically affected but also nutritionally influenced.

Similar to the results of height, irrespective of gender, subjects from KG (from all age groups) were heavier than their counterparts, also they surpassed the standard reference values of weight for age. Among AW groups, with the exception of boys aged 4+ & 5+ yrs; boys aged 3+ & girls aged 3+, 4+ & 5+ yrs were unable to meet the standard reference values of weight for age with % deficit ranged from 0.68 to 9.81. Among KG groups, girls & boys from age groups 3+, 4+ & 5+ yrs showed mean weights above the standard reference values of weight for age with % excess ranged from 2.15 to 15.0 (Table IV).

Irrespective of gender & age, subjects from KG had higher mean intake of energy & protein as compared to RDAs (Table V). Girls from AW from 3+ yrs & boys from AW from 3+, 4+ & 5+ yrs had deficient mean consumption of energy than RDAs.

Irrespective of the income level, age & gender, all groups showed mean intake of protein higher than RDAs (% excess ranged from 114.09 to 232.42, Table V).

Mean energy & protein intake of girls & boys from KG from all age groups was found to be higher than girls & boys from AW.

Mean carbohydrate intake of girls was found to be less than boys. Mean carbohydrate intake ranged from 137.68±18.37 to 211.17±22.76 g/day. Mean fat intake ranged from 30.66±3.35 to 56.92±4.17 g/day.

When PEFR was correlated with height, PEFR is increased as the height increased in both boys and girls from all age groups, however, correlations were insignificant (r=0.1088 to 0.2429 among girls & 0.0629 to 0.3350 among boys). PEFR increases progressively with age, weight, height and more so with height in both sexes (Reddy, U. N. et al., 2014). Paramesh, H. (2003) reported that PEFR values correlated best with height & there was no difference in sexes and urban/rural children aged 6-15 yrs.

As reported by Mohammadzadeh, I. I. et al. (2006) among 525 male & 525 female primary and secondary school's students, the PEFR was evaluated with increasing height & the rate of increase in boys was higher than girls. These researchers also reported more significant correlation between PEFR and height as compared to that between PEFR and weight among students they have studied.

For the present study, with the exception of AW girls from age group 3+ & KG girls from age group 5+; rest of the groups of girls reflected positive correlation of PEFR with body weight (r=0.1368 to 3542). With the exception of KG boys (4+ yrs) & AW boys (5+ yrs); rest of the groups of boys had direct relationship between PEFR & body weight (r=0.0635 to 0.3657) (Tables VI & VII).

With the exception of 3+ (KG girls) & 3+ (AW boys); majority groups of subjects had positive correlation of PEFR with intake of energy & energy yielding nutrients. The results clearly indicate positive impact of nutrient consumption on lung capacity.

PEFR was also found to be positively correlated with respiratory rate in all groups of girls & boys. Deep breathing can increase ventilatory capacity & thereby PEFR.

PEFR is affected by age as well as body measurements like height & weight. Good nutritional status of children can be helpful in keeping PEFR reading under "green" zone. Pollution can be one of the causes of lung

function deterioration among children which needs to be controlled. Besides healthy foods, healthy environment is needed for breathing of fresh air.

Table I: Age Wise Classification of Sample

Sr. No.	Age Group (years)	Subjects(N = 600)			
		Girls (n=150)		Boys (n=150)	
		KG	AW	KG	AW
1	3+	25	25	25	25
2	4+	25	25	25	25
3	5+	25	25	25	25

Table II: Classification of PEFR

Zone	Reading	Description
Green Zone	80 to 100 percent of the usual or normal peak flow readings are clear	A peak flow reading in the green zone indicates that the asthma is under good control.
Yellow Zone	50 to 79 percent of the usual or normal peak flow readings	Indicates caution. It may mean respiratory airways are narrowing and additional medication may be required.
Red Zone	Less than 50 percent of the usual or normal peak flow readings	Indicates a medical emergency. Severe airway narrowing may be occurring and immediate action needs to be taken. This would usually involve contacting a doctor or hospital.

Table III: Data on PEFR & Respiratory Rate of Subjects

Subjects& Age (yrs)			PEFR (L/minute)		Respiratory Rate (cycles/minute)	
			M±SD	Range	M±SD	Range
Girls	3+	KG	120.40±5.52	110-130	32.38±1.29	30-40
		AW	124.30±2.67	120-130	32.38±1.29	30-40
	4+	KG	120.40±5.52	110-130	32.38±1.29	30-34
		AW	120.40±5.52	110-130	31.10±1.09	30-34
	5+	KG	125.9±3.14	120-130	32.38±1.29	30-34
		AW	120.40±5.52	110-130	32.38±1.29	30-34
Boys	3+	KG	124.30±2.67	120-130	32.00±1.68	30-35
		AW	115.8±7.45	100-125	32.38±1.29	30-34
	4+	KG	120.40±5.52	110-130	31.10±1.09	30-34
		AW	115.8±7.45	100-125	31.10±1.09	30-34
	5+	KG	125.9±3.14	120-130	32.38±1.29	30-34
		AW	124.30±2.67	120-130	31.92±0.60	31-33

Table IV: Data on Anthropometric Measurements of Subjects

Subjects	Age (yrs)	Schools	Height (cm)			Weight (kg)		
			M±SD (Range)	Std*	%Excess /Deficit	M±SD (Range)	Std*	%Excess /Deficit
Girls	3+	KG	101.84± 4.40 (94-110)	98.2	+3.71	16.56±1.55 (14.50-20.5)	14.4	+15.0
		AW	96.37±5.75 (85-107)		-1.86	13.89±1.99 (10-17.50)		-3.54
	4+	KG	105.64± 2.83 (98-109)	105.1	+0.51	17.54±1.56 (15-22)	16	+9.63
		AW	99.98±5.66 (89-111)		-4.87	14.43±1.82 (11-18.2)		-9.81
	5+	KG	111.38±2.39 (104-116)	111	+0.34	18.08±1.22 (16.10-21.20)	17.7	+2.15
		AW	107.40±2.39 (100-112)		-3.24	17.57±1.29 (15.70-20.9)		-0.73
Boys	3+	KG	100.86± 4.86 (93-110)	99.1	+1.78	16.93±0.93 (15.10-19)	14.8	+14.39
		AW	97.11± 4.03 (91-105)		-2.00	14.70±0.93 (12.80-16.7)		-0.68
	4+	KG	106.78 ± 2.38 (103-113)	105.7	+1.02	17.90±0.79 (17-19)	16.5	+8.49
		AW	99.24 ± 4.50 (92-109)		-6.11	17.52±1.17 (15-20)		+6.18
	5+	KG	114.48± 2.17 (110-117)	111.5	+2.67	18.84±0.77 (18-20)	18.2	+3.52
		AW	110.48±2.17 (106-113)		-0.91	18.30±0.61 (17.40-19.6))		+0.55

Values in parentheses indicate Range; *-Standard (National Nutrition Monitoring Bureau/NIN/ICMR, 2002 & India Nutrition Profile, 1998).

Table V: Data on Nutrient Intake of Subjects

Subjects& Age (yrs)			Energy (kcal)			Carb (g)	Protein (g)			Fat (g)
			M±SD (Range)	RDA*	%Excess /Deficit	M±SD (Range)	M±SD (Range)	RDA*	%Excess /Deficit	M±SD (Range)
Girls	3+	KG	1459±116 (1108-1698)	1140	+27.98	209.60±22.52 (145.5-254.3)	49.52±3.09 (41.2-55.2)	16.8	+194.76	47.61±3.09 (40.1-53.6)
		AW	966±101 (725-1166)		-15.26	137.68±18.37 (100-175.20)	35.98±7.56 (20.2-57.8)		+114.17	30.66±3.35 (24.2-38.2)
	4+	KG	1529±111 (1329-1723)	1192	+28.27	193.28±17.87 (167.8-235.6)	59.17±3.64 (51.2-65.4)	17.8	+232.42	56.92±4.17 (45.6-63.4)
		AW	1260±108 (1021-1441)		+5.71	164.61±19.86 (125-198)	44.4±7.18 (20.2-58.2)		+149.44	47.61±3.09 (40.1-53.6)
	5+	KG	1518±111 (1317-1749)	1277	+18.87	195.07±17.97 (169.3-238.4)	57.23±3.8 (50-65)	19.3	+196.53	48.09±2.93 (40.1-53.7)
		AW	1307±69 (1144-1457)		+2.35	172.15±16.69 (134-215.4)	49.52±3.09 (41.2-55.2)		+156.58	47.39±3.03 (40.1-53.2)
Boys	3+	KG	1469±116 (1112-1699)	1217	+20.71	211.17±22.76 (146.5-256.3)	50.11±3.25 (41.3-55.6)	17.2	+191.34	48.09±2.93 (40.1-53.7)
		AW	1112±79 (835-1240)		-8.63	159.18±16.6 (108.3-189.5)	40.78±5.11 (30-50)		+137.09	34.89±3.59 (26.5-42)
	4+	KG	1518±111 (1317-1749)	1283	+18.31	195.07±17.97 (169.3-238.4)	59.18±3.67 (51.2-65.4)	18.3	+223.39	56.92±4.17 (45.6-63.4)
		AW	1219±78 (1010-1363)		-4.99	211.17±22.76 (146.5-256.3)	50.11±3.25 (41.3-55.6)		+173.83	48.09±2.93 (40.1-53.7)
	5+	KG	1469±116 (1112-1699)	1375	+6.84	146.9±22.07 (108.3-189.5)	42.39±12.98 (20.3-67.3)	19.8	+114.09	48.09±2.93 (40.1-53.7)
		AW	1312±101 (1135-1546)		-4.58	195.07±17.97 (169.3-238.4)	50.11±3.25 (41.3-55.6)		+153.08	48.09±2.93 (40.1-53.7)

Values in parentheses indicate Range; *-Recommended Dietary Allowances-(National Institute of Nutrition (NIN)/Indian Council of Medical Research (ICMR), 2009); Carb-Carbohydrate.

Table VI: Correlates of PEFR for Girls

Correlation between PEFR and:	Subjects					
	Girls (Age in Yrs)					
	3+		4+		5+	
	KG	AW	KG	AW	KG	AW
Height	0.2422	0.1088	0.1855	0.1374	0.1165	0.2429
Weight	0.2897*	-0.1349	0.3542*	0.1368	-0.2707	0.3424*
Respiratory Rate	0.0212	0.0986	0.0211	0.1793	0.0396	0.0211
Energy Intake	-0.0172	0.0269	0.0937	0.0430	-0.0355	0.0061
Carbohydrate Intake	-0.0346	0.1337	0.1000	0.0416	0.0058	0.0204
Protein Intake	-0.0660	0.0410	-0.0358	0.1388	-0.0936	-0.0660
Fat Intake	0.1265	-0.2906*	0.0861	0.1264	0.0481	0.0041

* - Significant at 5 % level but insignificant at 1 % level (0.01<p<0.05). Values without any mark indicate insignificant difference at both 5% & 1% levels (p>0.05).

Table VII: Correlates of PEFR for Boys

Correlation between PEFR and:	Subjects					
	Boys (Age in Yrs)					
	3+		4+		5+	
	KG	AW	KG	AW	KG	AW
Height	0.2464	0.2572	0.0629	0.3350*	0.0347	0.1168
Weight	0.3657*	0.3187*	-0.1312	0.0635	-0.0225	0.0125
Respiratory Rate	0.0227	0.0958	0.1793	0.1780	0.0396	0.1626
Energy Intake	0.0662	-0.2399	0.0503	-0.1424	-0.0239	-0.0552
Carbohydrate Intake	0.0684	-0.1417	0.0855	0.1258	0.0560	0.0208
Protein Intake	0.1143	-0.0766	-0.0279	0.1832	0.1123	0.1143
Fat Intake	0.0801	-0.3020*	0.0861	0.1031	0.0481	0.0801

* - Significant at 5 % level but insignificant at 1 % level (0.01<p<0.05). Values without any mark indicate insignificant difference at both 5% & 1% levels (p>0.05).

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