



Normalized Maximal Blood Pressure by Age at Peak Exercise in Healthy Children

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Background

- Exercise testing in pediatrics has widespread clinical utility.
- Normative data for pediatric exercise testing is limited, making the results of exercise testing difficult to interpret.
- Large scale studies for normalized maximal blood pressures (BP) by age, sex, and body mass index (BMI) are needed.

Objective

- Establish values for maximum blood pressure during peak exercise, by reporting sex, age, and BMI-stratified normalized maximal blood pressure values in healthy pediatric patients undergoing exercise testing.

Methods

- Chart review of exercise tests performed by either the Bruce treadmill protocol or bicycle ramp exercise study protocol at St. Christopher's Hospital for Children between 2008 and 2019.
- 883 healthy children with structurally normal hearts, aged 7-14 years old who reached at least 85% of maximum predicted heart rate for age were included in the study.

Results

Age	Sex	n	Systolic			Diastolic		
			50	90	95	50	90	95
<9	Female	39	139.0	169.0	185.0	61.0	85.2	89.3
	Male	68	140.0	165.1	180.5	62.0	82.2	92.4
9-12	Female	141	152.0	177.8	190.0	67.0	86.0	88.9
	Male	206	150.5	184.0	194.3	66.0	84.0	87.8
>12	Female	147	154.0	181.2	189.8	65.5	82.0	92.7
	Male	177	170.0	205.4	214.2	66.0	85.1	94.1

Table 1 (above): Percentile of peak systolic and diastolic BP by age and sex

Age	BMI Group					
	Healthy		Overweight		Obese	
	Female	Male	Female	Male	Female	Male
<9	34	53	1	13	13	21
9-12	95	135	25	42	40	57
>12	108	123	31	31	23	31
Total	237	311	57	86	73	109

Table 2 (above): Number of patients in each age, BMI and sex group

Table 3 (below): Percentile of peak systolic and diastolic BP by age, sex, BMI

Age	Sex	Healthy						Overweight						Obese					
		Systolic			Diastolic			Systolic			Diastolic			Systolic			Diastolic		
		50	90	95	50	90	95	50	90	95	50	90	95	50	90	95	50	90	95
<9	Female	136	169	198	61	85	88							145			60		
	Male	135	164	171	66	83	93	123	149		49	63		150	196		64	101	
9-12	Female	147	171	188	68	84	88	154	176	178	63	95	100	160	197	201	66	87	95
	Male	149	180	192	65	83	86	153	178	194	70	87	92	154	201	205	68	86	92
>12	Female	154	181	184	66	84	93	152	182	187	65	84	98	162	202	207	61	74	93
	Male	169	200	214	67	88	91	168	212	218	60	81	83	180	211	226	71	100	108

Results

- When grouped by sex and age group, peak systolic and diastolic BP values across all percentiles increased by age.
- Patients were then classified into one of three BMI status groups.
- Peak systolic BP for each percentile generally increased by age group and by BMI group, with the highest peak pressures in the obese groups.
- This effect was seen across males and females, with males generally having a higher peak blood pressures than females.

Conclusions

- As age and BMI status increases in males and females, there is an increase in peak blood pressure (particularly systolic).
- This study encompasses a heterogeneous population in Northeast Philadelphia, providing more widely applicable data than previous studies, which are based on homogeneous populations.
- A larger heterogeneous population is needed to establish more reliable BP parameters at peak exercise, particularly in patients <9yo
- Given that the BPs were obtained by listening to the Korotkoff sounds, and not using an electronic device, they are more accurate. However, there is a possibility for error based on use of improper blood pressure cuff size.