

Sex Differences in Stiffness Parameters following Maximal Exercise

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Objectives: The sex differences found in cardiovascular disease risk and progression are well established. These discrepancies are potentially attributed to the cardioprotective effect of estrogen or sex specific differences in fitness. There may also be sex differences in the cardiovascular responses to exercise, which could underlie this disease risk. We investigated arterial stiffness parameters at rest and following maximal exercise in untrained males and females.

Methods: Eighty-three young (mean age=25 years), healthy males (n= 39) and females (n=44) underwent measures of vascular stiffness at rest and both 15 and 30 minutes (po15, po30) following maximal exercise. The exercise stimulus was an acute progressive maximal exercise bout on a cycle ergometer.

Results: Females had significantly lower pressures (carotid, aortic and brachial) at all time points compared to males, with no heart rate differences. Arterial compliance (AC) and Elastic Modulus (Ep) changed similarly between sexes, with a decreased compliance at po15, returning to baseline values at po30. Males had significantly elevated central stiffness (cPWV) at both rest and po15 compared to females, but significantly decreased at po30 to match values of the females. The significance in cPWV between sexes remained after controlling for aortic MAP.

Conclusions: Females have a less stiff resting arterial profile compared to males. However, with maximal exercise, males altered their arterial profile to eliminate any significant differences between females in stiffness indices. This suggests that a maximal bout of exercise is an appropriate stimulus for evaluating stress induced sex differences in arterial stiffness.

Table 1: Descriptive Statistics

	Total (n=83)	Males (n=39)	Females (n=44)
Age (yr)	25.3 ± 0.8	25.2 ± 1.5	24.9 ± 0.7
BMI (kg/m ²)	27.2 ± 0.8	26.7 ± 0.7	27.6 ± 1.3
Height (cm) *	170.2 ± 1.1	178.2 ± 0.9	163.2 ± 1.
Weight (kg) *	79.1 ± 2.4	84.9 ± 2.4	74.1 ± 4.0
VO ₂ peak (ml/kg/min) *	33.1 ± 0.9	38.4 ± 1.3	28.3 ± 0.9

Table 2: Pressure and stiffness response before and following maximal exercise

	Males			Females		
	rest	Post15	Post30	rest	Post15	Post30
bMAP (mmHg)	90±1*	92±2*	89±1* #	85±1	84±2	84±1
aorMAP (mmHg)	87±1*	90±2*	88±1*	84±1	82±1	82±1
HR (bpm)	63±2	86±2 \$	79±2 \$#	65±1	83±2 \$	78±2 \$#
cPWV (m/s)	6.12±0.17*	6.21±0.15*\$	5.84±0.17\$	5.50±0.16	5.34±0.14	5.56±0.15
Ep (kPa)	72.51±3.42*	81.09±4.52	71.51±3.93	61.33±3.12	71.41±4.13\$	66.14±3.49
AC (mm ² /kPa)	1.14±0.07*	0.97±0.07\$	1.12±0.06#	1.31±0.06	1.10±0.06\$	1.22±0.06#
B-stiffness	5.81±0.27	6.23±0.33	5.71±0.32	5.24±0.24	6.10±0.30\$	5.71±0.29

*p<0.05 between sexes
\$ sig diff from rest
#sig diff from po15