

CHAPTER-6

Results

6.0	RESULTS	107-137
6.1	Cerebrovascular hemodynamics in <i>Yoga</i> & Non- <i>Yoga</i> Practitioners	109
6.2	Cardiovascular Functions in <i>Yoga</i> and Non- <i>Yoga</i> Practitioners	111
6.3	Breath holding time (BHT) in <i>Yoga</i> and Non- <i>Yoga</i> Practitioners	113
6.4	Cerebrovascular Hemodynamics during Various <i>Pranayama</i> Techniques & a <i>Yogic Kriya</i>	115
6.5	Cardiovascular functions during Various <i>Pranayama</i> Techniques & a <i>Yogic Kriya</i>	129

6.0 RESULT:

Phase 1:

Of seventy-two subjects, 42 subjects did not fulfill the inclusion criteria and hence not included in the study. The Recruited 30 subjects [*Yoga* practitioners ($n = 15$) and non-*Yoga* practitioners ($n = 15$)] were assessed for the measures of cerebrovascular and cardiovascular functions. The demographic variables of both *Yoga* practitioners and non-*Yoga* practitioners groups were comparable and there was no significant difference between groups. The details of the demographic variables of the both *Yoga* practitioners and non-*Yoga* practitioners groups were given in table 3.

Table 3: Demographic Variables recorded in both groups i.e., *Yoga* ($n= 15$) and Non-*Yoga* ($n=15$) practitioners (Independent samples-t-test)

Variables	Yoga Group	Non-Yoga Group	Independent Samples-t-test	
			<i>t</i> value	<i>p</i> value
Age (Years)	23.62±3.57	22.69±4.05	0.616	0.543
Gender	Males ($n= 14$), Female ($n= 1$)	Males ($n= 14$), Female ($n= 1$)	–	–
Height (m)	1.68±0.08	1.67±0.11	0.164	0.871
Weight (kg)	58.92±7.64	59.23±8.39	-0.098	0.923
BMI (Kg/m ²)	20.92±2.27	21.31±3.30	-0.350	0.729
Note: All values are in Mean ± Standard deviation. BMI = Body mass index				

6.1 Cerebrovascular hemodynamics between Yoga and Non-Yoga Practitioners:

Result of this present study showed no statistical significant difference in cerebrovascular hemodynamics such as PSV, EDV, MFV and PI between *Yoga* and non-*Yoga* practitioners table 4.

Table 4: Cerebrovascular Hemodynamics of *Yoga* (n=15) and Non-*Yoga* (n=15) Groups

Variables	<i>Yoga</i> Group (n=15)	Non- <i>Yoga</i> Group (n=15)	Independent samples-t-test	
			<i>t</i> value	<i>p</i> value
PSV (cm/sec)	57.82±14.61	53.74±13.09	0.805	0.427
EDV (cm/sec)	22.66±5.15	20.79±5.21	0.990	0.331
MFV (cm/sec)	34.73±7.86	33.03±8.73	0.563	0.578
PI	1.02±0.17	1.02±0.18	0.074	0.942
Note: All the values are group Mean ± Standard deviation. PSV = Peak systolic velocity; EDV = End diastolic velocity; MFV = Mean flow velocity; PI = Pulsatility index				

Figure 6: Cerebrovascular hemodynamic changes in *Yoga* and *Non-Yoga* Practitioners

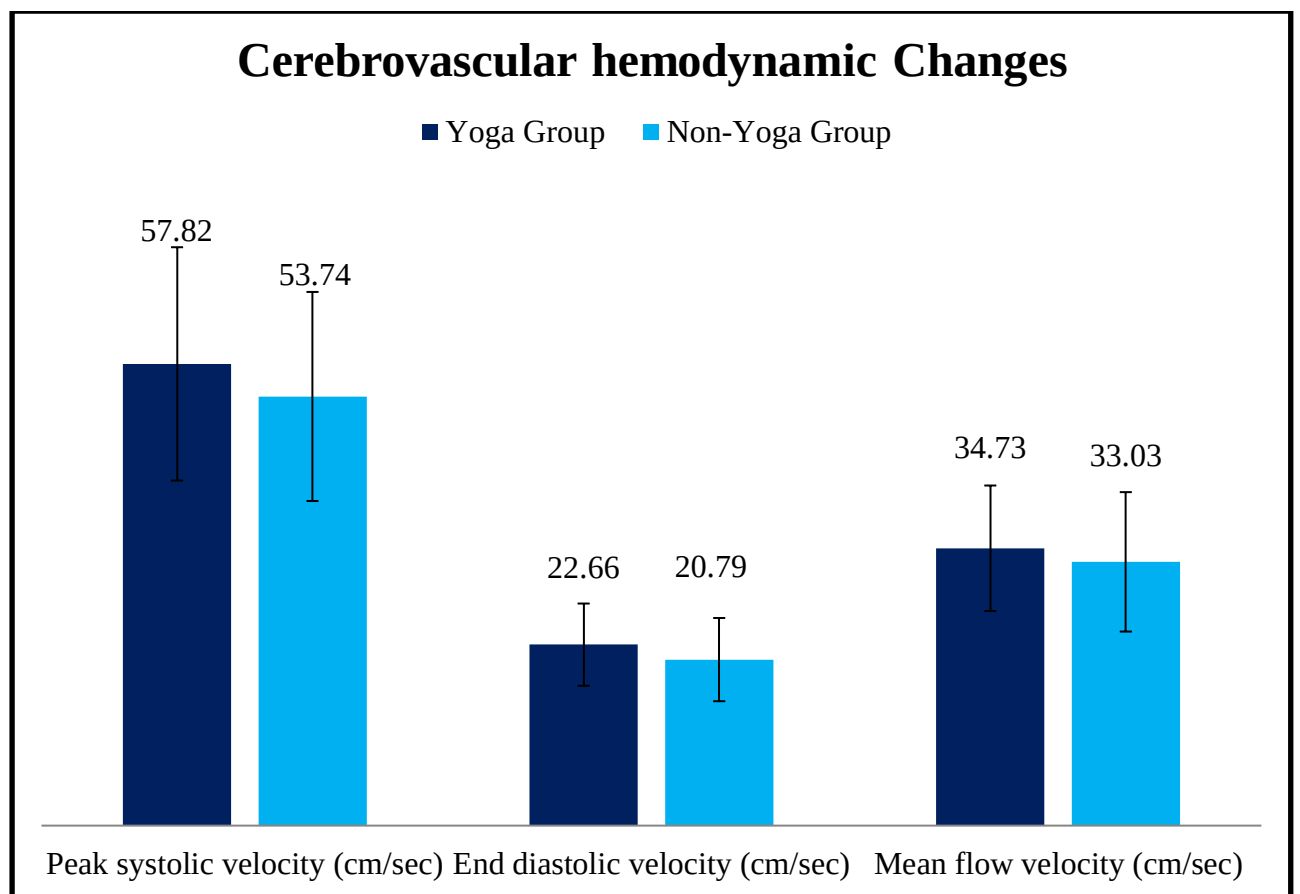
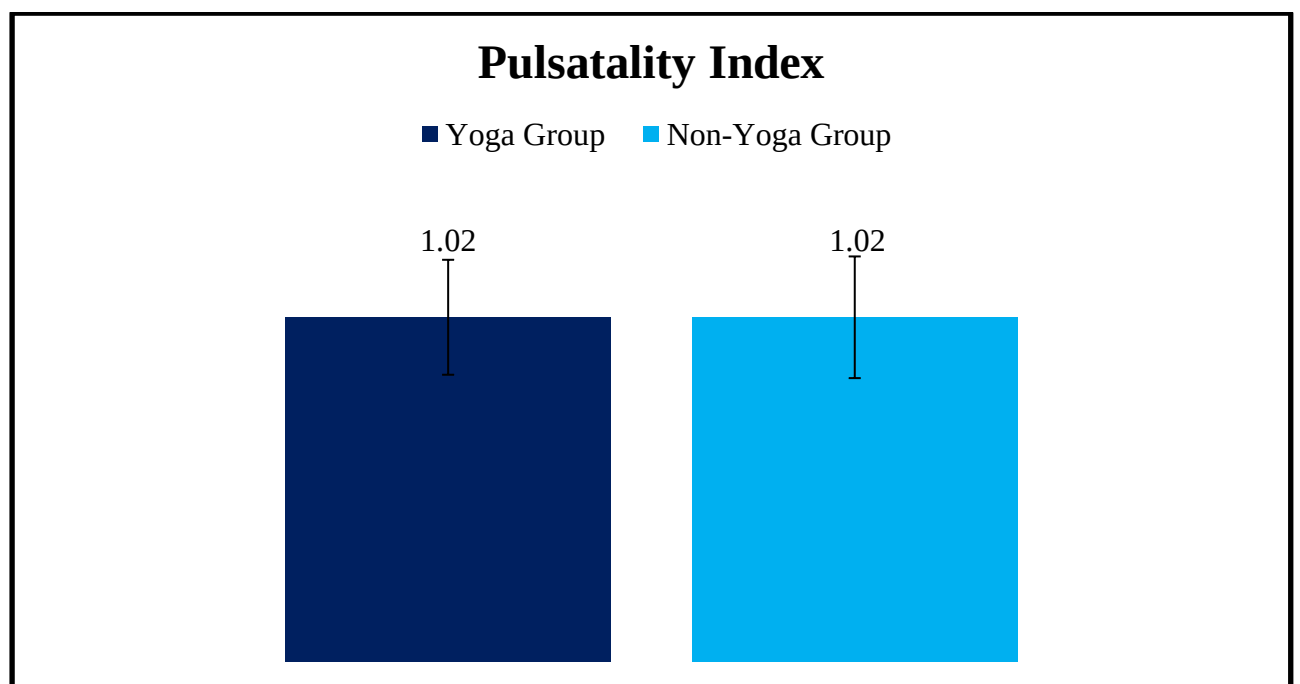


Figure 7: Pulsatility Index of *Yoga* and *Non-Yoga* Practitioners



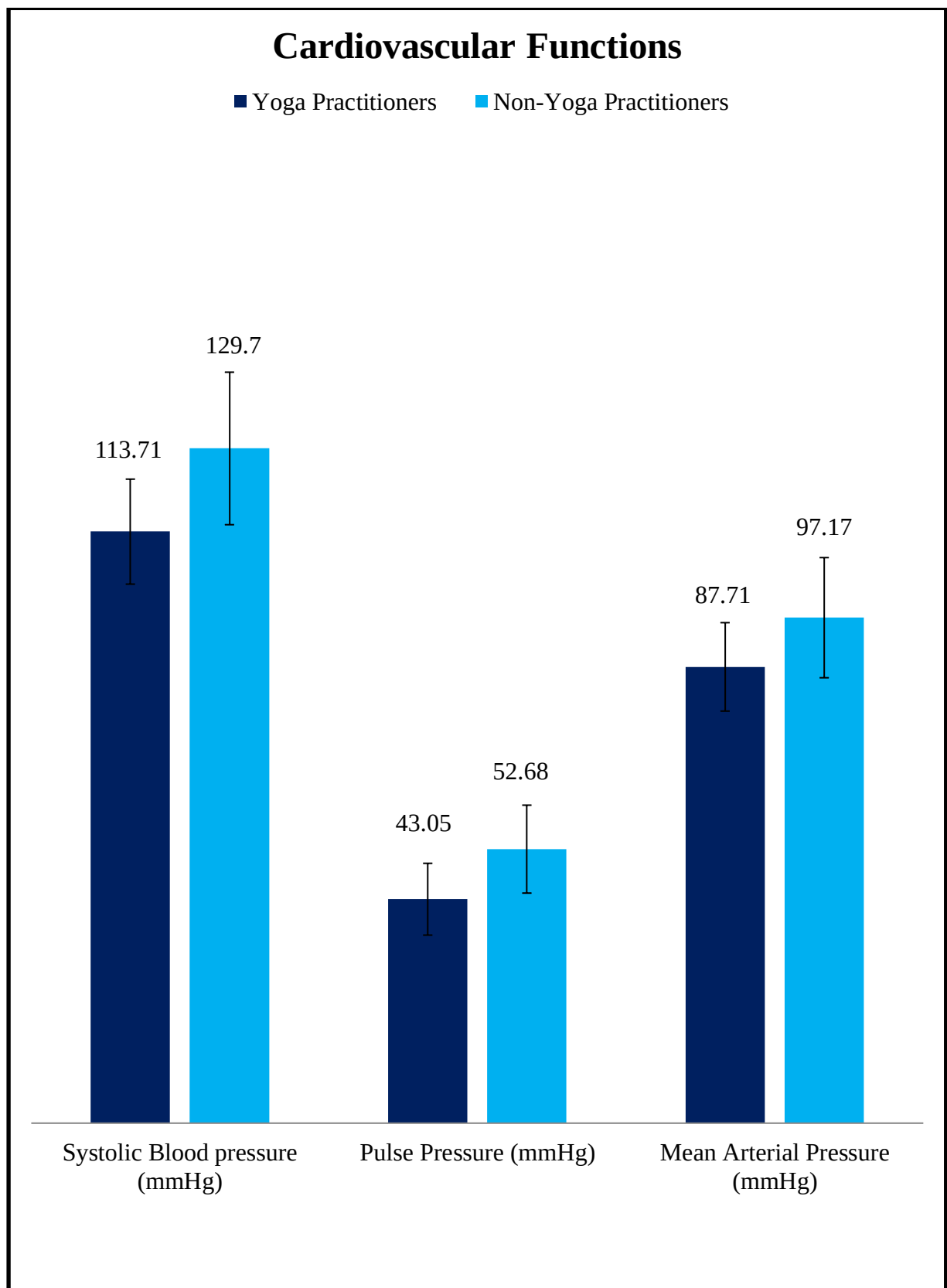
6.2 Cardiovascular Functions in Yoga and Non-Yoga Practitioners:

Result of this present study showed a significant difference in SBP, PP and MAP while no such significant differences were observed in rest of variables between *Yoga* and non-*Yoga* practitioners (Table 4).

Table 5: Cardiovascular functions of *Yoga* Practitioners ($n= 15$) and Non-*Yoga* ($n=15$) practitioners groups (Independent samples-t-test)

Variables	Yoga Group	Non-Yoga Group	Independent-t-test	
			t value	p value
SBP (mmHg)	113.71±10.09	129.70±14.66	-3.240	0.003**
DBP (mmHg)	70.66±7.69	77.02±11.03	-1.705	0.101
PP (mmHg)	43.05±6.90	52.68±8.45	-3.183	0.004**
MAP (mmHg)	87.71±8.50	97.17±11.55	-2.379	0.026*
HR (beats/min)	80.94±7.90	77.40±8.49	1.100	0.282
SV (ml)	69.56±14.34	79.70±15.96	-1.704	0.101
LVET (ms)	274.30±17.92	287.55±14.93	-2.048	0.052
CO (l/min)	5.59±1.31	6.05±1.04	-1.007	0.324
PI (ms)	755.63±83.13	801.29±86.17	-1.375	0.182
TPR (mmHg.min/l)	1.04±0.26	1.12±0.39	-0.615	0.544
Note: All values are in Mean ± Standard deviation. * = p value < 0.05; ** = p value < 0.01 and *** p value < 0.001. SBP= Systolic blood pressure; DBP= Diastolic blood pressure; PP = Pulse pressure MAP = mean arterial pressure; HR = Heart rate; SV = Stoke volume; LVET = Left ventricular ejection time; CO = cardiac output; PI = Pulse Interval; TPR = Total peripheral resistant.				

Figure 8: Cardiovascular functions of *Yoga* & *Non-Yoga* Practitioners



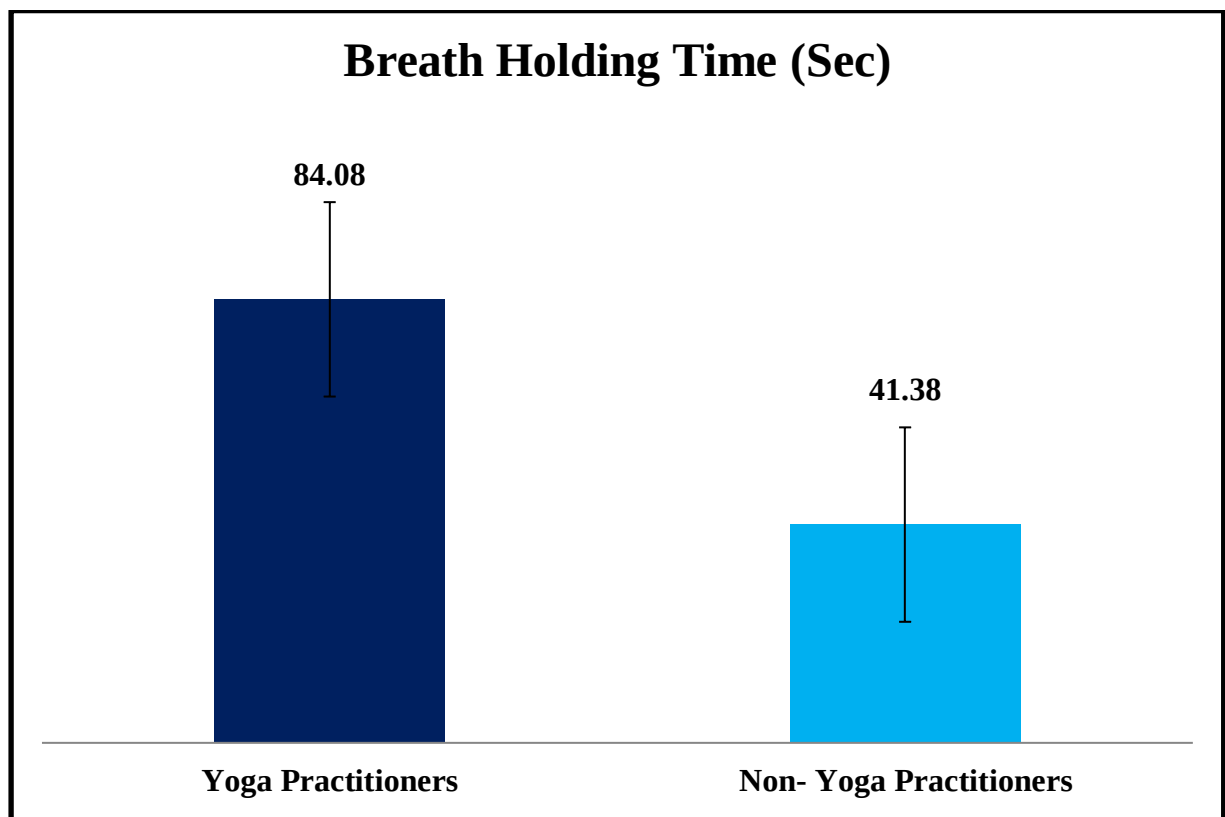
6.3 Breath holding time (BHT) between Yoga and Non-Yoga Practitioners:

Result of this study showed a significant increase in BHT in Yoga Practitioners compared to Non-Yoga group (Table 6)

Table 6: Breath holding time of Yoga Practitioners ($n= 15$) and Non-Yoga ($n=15$) practitioners groups (Independent samples-t-test)

Variables	Yoga Group	Non-Yoga Group	Independent Samples-t-test	
			<i>t</i> value	<i>p</i> value
BHT (Sec)	84.08±17.32	41.38±18.43	6.086	<0.001***
Note: All values are in Mean ± Standard deviation. *** <i>p</i> value <0.001. BHT = Breath holding time				

Figure 9: Breath holding time of Yoga ($n= 15$) & Non-Yoga ($n=15$) practitioners



Phase 2:

Recruited 20 subjects were advised to perform different *Pranayama* techniques in a specified order as mentioned in the study design. Two subject's cerebrovascular hemodynamics was not measured due to difficulty in getting the proper TCD window. Hence, did not include in the cerebrovascular hemodynamics analysis. Baseline assessments were taken at rest and during and post. Test assessments were taken during and immediately after the practice of each *Pranayama* techniques. Demographic variables of the study subjects were provided in table 7.

Table 7: Demographic Variables of the Study Group ($n = 20$)

Variables	Study Group ($n = 20$)
Age (Years)	23.40±3.05
Gender	Males ($n = 19$) and Female ($n = 1$)
Height (m)	1.70±0.09
Weight (kg)	60.05±8.53
Body Mass Index (kg/m ²)	20.87±2.24

6.4 Cerebrovascular Hemodynamics during Various Pranayama Techniques & a Yogic

Kriya:

Normal breathing (baseline):

The Repeated Measures ANOVA, where Mauchly's sphericity was assumed, showed no significant difference in the within subjects factor i.e., time points for PSV [$F(4, 68) = 0.770$, $p = 0.549$], EDV [$F(4, 68) = 0.621$, $p = 0.649$], MFV [$F(4, 68) = 0.240$, $p = 0.915$], and PI [$F(4, 68) = 0.520$, $p = 0.721$] (Table 8).

Bhastrika:

The Repeated Measures ANOVA, where Mauchly's sphericity was violated, hence Greenhouse-Geisser correction was applied to degree of freedom (df), showed significant changes within subjects between time points for EDV [$F(1.917, 24.923) = 19.210$, $p < 0.001$], MFV [$F(1.549, 20.133) = 8.140$, $p = 0.004$], and PI [$F(1.933, 25.124) = 17.336$, $p < 0.001$] and no significant changes within subjects between time points for PSV [$F(1.402, 18.222) = 0.405$, $p = 0.601$]. Post-hoc analysis with Bonferroni correction revealed that during the practice, a significant reduction in EDV, and MFV with increase in PI was observed simultaneously across 4 data points after 15 seconds (15, 30, 45 and 60 sec). In recovery period, PI, EDV and MFV revert back to normal after 15 seconds, 30 seconds and 45 seconds respectively (Table 9 & Figure 7-10).

Kapalbhati:

The Repeated Measures ANOVA, where Mauchly's sphericity was assumed, showed significant changes within subjects between time points for EDV [$F(8, 136) = 29.306$, $p < 0.001$]. The Repeated Measures ANOVA, where Mauchly's sphericity was violated, hence Greenhouse-Geisser correction was applied to df, showed significant changes within subjects between time points for, MFV [$F(2.799, 47.580) = 23.146$, $p < 0.001$], and PI [$F(4.007, 68.15) = 23.307$, $p < 0.001$] and no significant changes within subjects between time points

for PSV [$F(3.648, 62.019) = 1.510, p = 0.214$]. Post-hoc analysis using Bonferroni correction revealed that during the practice, a significant reduction in EDV, and MFV with increase in PI was observed from 15 seconds to 60 seconds. In recovery period, PI, and EDV revert back to normal after 15 seconds, while MFV revert back to normal after 30 seconds. (Table 11 & Figure 7-10).

Internal Kumbhaka:

The Repeated Measures ANOVA, where Mauchly's sphericity was violated, hence Greenhouse-Geisser correction was applied to df, showed significant changes within subjects between time points for EDV [$F(1.892, 24.597) = 4.505, p = 0.025$], MFV [$F(1.620, 21.063) = 5.805, p = 0.014$], and PI [$F(2.425, 31.526) = 3.283, p = 0.042$] and no significant changes within subjects between time points for PSV [$F(1.510, 19.633) = 3.046, p = 0.082$]. Post-hoc analysis using Bonferroni correction revealed that during the practice, a significant increase in PSV, EDV, and MFV with reduction in PI was observed from 30 seconds to 60 seconds. In recovery period, EDV and PI were reverted back to normal within 15 seconds, while MFV and PSV revert back to normal within 30 seconds. (Table 12, Figure 7-10)

External Kumbhaka:

The Repeated Measures ANOVA, where Mauchly's sphericity was assumed, showed a significant change within subjects between time points for PSV [$F(7, 119) = 8.028, p < 0.001$]. The Repeated Measures ANOVA, where Mauchly's sphericity was violated, hence Greenhouse-Geisser correction was applied to df, showed significant changes within subjects between time points for EDV [$F(3.317, 56.39) = 14.014, p < 0.001$], MFV [$F(2.359, 40.096) = 14.446, p < 0.001$], and PI [$F(3.826, 65.047) = 10.055, p < 0.001$]. Post-hoc analysis using Bonferroni correction revealed that during the practice, a significant increase in EDV, and MFV with reduction in PI was observed in 30 seconds. In recovery period, EDV, MFV and PI revert back to normal within 15 seconds. (Table 13, Figure 15-18).

Bhramari Pranayama:

The Repeated Measures ANOVA, where Mauchly's sphericity was violated, hence Greenhouse-Geisser correction was applied to df, showed significant changes within subjects between time points for PSV [$F(4.651, 79.072) = 2.898, p = 0.021$] and no significant changes within subjects between time points for EDV [$F(4.643, 78.937) = 1.214, p = 0.311$], MFV [$F(4.096, 69.638) = 3.882, p = 0.006$], and PI [$F(4.588, 77.990) = 1.653, p = 0.161$] (Table 10, Figure 11-14).

Table 8: Cerebrovascular hemodynamics during Normal Breathing ($n = 18$) [RMANOVA with post hoc analysis and Bonferroni adjustment]

Parameter	0 Second	15 Seconds	30 Seconds	45 Seconds	60 Seconds
PSV (cm/s)	58.56±18.64	59.06±18.99	59.67±18.31	58.11±17.65	59.28±18.15
EDV (cm/s)	22.94±8.95	21.56±5.16	22.33±7.53	22.28±7.92	21.78±6.25
MFV (cm/s)	34.94±12.24	34.22±11.02	34.72±10.90	34.39±10.37	34.78±9.92
PI	1.04±0.22	1.08±0.19	1.08±0.20	1.05±0.23	1.07±0.21
All values are in mean ± Standard deviation. * = p value < 0.05. RMANOVA= Repeated measures of analysis of variance; PSV = Peak systolic velocity; EDV = End diastolic velocity; MV = Mean velocity; PI = Pulsatility index					

Table 9: Cerebrovascular hemodynamics during *Bhastrika* ($n = 18$) [RMANOVA with post hoc analysis and Bonferroni adjustment]

Parameter	During <i>Bhastrika</i> ($n=18$)					Post-Test Assessments ($n=18$)			
	Baseline	15 seconds	30 seconds	45 seconds	60 seconds	15 seconds	30 seconds	45 seconds	60 seconds
PSV (cm/s)	52.53±15.39	51.87±15.02	56.13±18.62	52.53±18.21	50.87±15.71	51.07 ± 17.66	48.57 ± 16.44	47.93 ± 15.02*	49.07 ± 15.80
EDV (cm/s)	21.67±7.53	4.67±6.85*	3.80±6.57*	3.67±6.48*	5.07±6.67*	13.86 ± 10.58*	17.21 ± 10.42*	18.07 ± 9.97	19.00 ± 10.81
MFV (cm/s)	34.20±10.81	22.87±7.93*	22.80±8.02*	22.00±7.30*	22.27±6.52*	26.64 ± 10.53*	29.29 ± 12.30*	29.36 ± 10.40*	31.29 ± 11.69
PI	0.91±0.16	2.26±0.88*	2.43±0.76*	2.34±0.79*	2.16±0.68*	1.58 ±.72*	1.27 ±.76	1.10 ± 0.46	1.08 ± 0.43
All values are in mean ±standard deviation. * = p value < 0.05. RMANOVA= Repeated measures of analysis of variance; PSV = Peak systolic velocity; EDV = End diastolic velocity; MV = Mean velocity; PI = Pulsatility index									

Table 10: Cerebrovascular hemodynamics during *Bhramari Pranayama* (n = 18) [RMANOVA with post hoc analysis and Bonferroni adjustment]

Parameter	During <i>Bhramari</i> (n=18)						Post-Test Assessments (n=18)			
	0 Second	1 Minute	2 Minutes	3 Minutes	4 Minutes	5 Minutes	15 Seconds	30 Seconds	45 Seconds	60 Seconds
PSV (cm/s)	55.89±19.98	53.89±19.39	52.28±16.24	51.72±17.87	51.72±19.03	52.50±18.63	52.61±18.72	53.06±19.68	56.00±22.38	57.44±21.70
EDV (cm/s)	20.61±6.90	19.28±6.28	20.67±6.24	19.94±5.74	20.56±7.01	21.33±7.19	19.06±8.86	20.39±8.45	21.00±10.44	22.61±8.52
MFV (cm/s)	33.83±10.59	30.61±10.29	31.94±9.36	30.28±9.46	30.39±11.25	32.89±10.06	31.06±11.50	31.67±10.86	34.22±14.36	35.78±14.12
PI	1.03±0.28	1.11±0.26	1.00±0.27	1.03±0.24	1.02±0.26	0.93±0.19	1.10±0.22	1.02±0.20	0.97±0.30	0.98±0.16
All values are in mean ±standard deviation. * = <i>p</i> value < 0.05. RMANOVA= Repeated measures of analysis of variance; PSV = Peak systolic velocity; EDV = End diastolic velocity; MV = Mean velocity; PI = Pulsatility index										

Table 11: Cerebrovascular hemodynamics during *Kapalbhati kriya* ($n = 18$) [RMANOVA with post hoc analysis and Bonferroni adjustment]

Parameter	During <i>Kapalbhati</i> ($n=18$)					Post-Test Assessments ($n=18$)			
	0 Second	15 Seconds	30 Seconds	45 Seconds	60 Seconds	15 Seconds	30 Seconds	45 Seconds	60 Seconds
PSV (cm/s)	58.56±19.18	54.28±15.60	57.11±18.13	54.72±17.88	54.33±17.62	53.89±18.33	53.72±19.08	54.89±21.28	55.67±20.42
EDV (cm/s)	22.56±8.00	8.72±9.30*	6.39±8.10*	6.61±8.47*	9.78±7.48*	14.00±9.73*	18.11±10.06	18.28±9.81	20.22±9.47
MFV (cm/s)	36.89±11.67	26.72±8.58*	24.78±8.22*	24.33±8.29*	24.39±8.60*	27.56±9.92*	30.83±12.01*	33.06±15.28	34.17±12.89
PI	0.97±0.20	1.82±0.64*	2.19±0.74*	2.14±0.81*	1.98±0.81*	1.55±0.61*	1.28±0.61	1.27±0.74	1.07±0.37
All values are in mean ±standard deviation. * = p value < 0.05. RMANOVA= Repeated measures of analysis of variance; PSV = Peak systolic velocity; EDV = End diastolic velocity; MV = Mean velocity; PI = Pulsatility index									

Table 12: Cerebrovascular hemodynamics during Internal *Kumbhaka* ($n = 18$) [RMANOVA with post hoc analysis and Bonferroni adjustment]

Parameter	During Internal <i>Kumbhaka</i> ($n=18$)					Post-Test Assessments ($n=18$)			
	Baseline	15 seconds	30 seconds	45 seconds	60 seconds	15 seconds	30 seconds	45 seconds	60 seconds
PSV (cm/s)	50.73±12.41	50.60±11.84	55.20±12.53*	58.60±12.57*	65.27±13.75*	60.57 ± 15.08*	53.71 ± 12.89	52.71 ± 15.26	54.71 ± 15.10*
EDV (cm/s)	17.27±7.33	18.47±7.24	22.67±8.24*	25.73±9.84*	28.67±12.03*	21.50 ± 10.80	16.14 ± 7.81	16.79 ± 9.59	18.14 ± 8.76
MFV (cm/s)	30.00±7.67	28.93±7.04	33.87±8.77*	38.80±10.25*	43.67±12.85*	36.00 ± 12.21*	29.57 ± 8.84	31.29 ± 10.78	31.86 ± 9.45
PI	1.20±0.38	1.11±0.34	0.99±0.25*	0.89±0.28*	0.90±0.31*	1.17 ± 0.36	1.35 ± 0.42	1.20 ± 0.29	1.19 ± 0.34
All values are in mean ± Standard deviation. * = p value < 0.05. RMANOVA= Repeated measures of analysis of variance; PSV = Peak systolic velocity; EDV = End diastolic velocity; MV = Mean velocity; PI = Pulsatility index									

Table 13: Cerebrovascular hemodynamics during External *Kumbhaka* ($n = 18$) [RMANOVA with post hoc analysis and Bonferroni adjustment]

Parameter	During External <i>Kumbhaka</i> ($n=18$)				Post-Test Assessments ($n=18$)			
	0 Second	10 Seconds	20 Seconds	30 Seconds	15 Seconds	30 Seconds	45 Seconds	60 Seconds
PSV (cm/s)	55.83±19.81	55.33±17.35	59.61±19.74	63.50±20.95	58.33±19.98	54.50±20.39	56.28±20.34	55.67±19.42
EDV (cm/s)	20.50±7.82	20.33±5.96	25.22±9.43	31.44±13.34*	19.78±5.73	19.78±5.85	20.28±9.40	20.33±9.20
MFV (cm/s)	33.56±12.08	32.44±9.15	37.89±13.83	44.78±17.61*	33.17±10.13	32.06±10.04	32.89±12.87	33.56±12.01
PI	1.06±0.22	1.07±0.25	0.93±0.20	0.74±0.14*	1.16±0.28	1.05±0.19	1.12±0.24	1.12±0.25
All values are in mean ±standard deviation. * = p value < 0.05. RMANOVA= Repeated measures of analysis of variance; PSV = Peak systolic velocity; EDV = End diastolic velocity; MV = Mean velocity; PI = Pulsatility index								

Figure 10: Peak Systolic Velocity (cm/seconds) before, during and after *Bhastrika*, Internal Kumbhaka & Kapalbhata

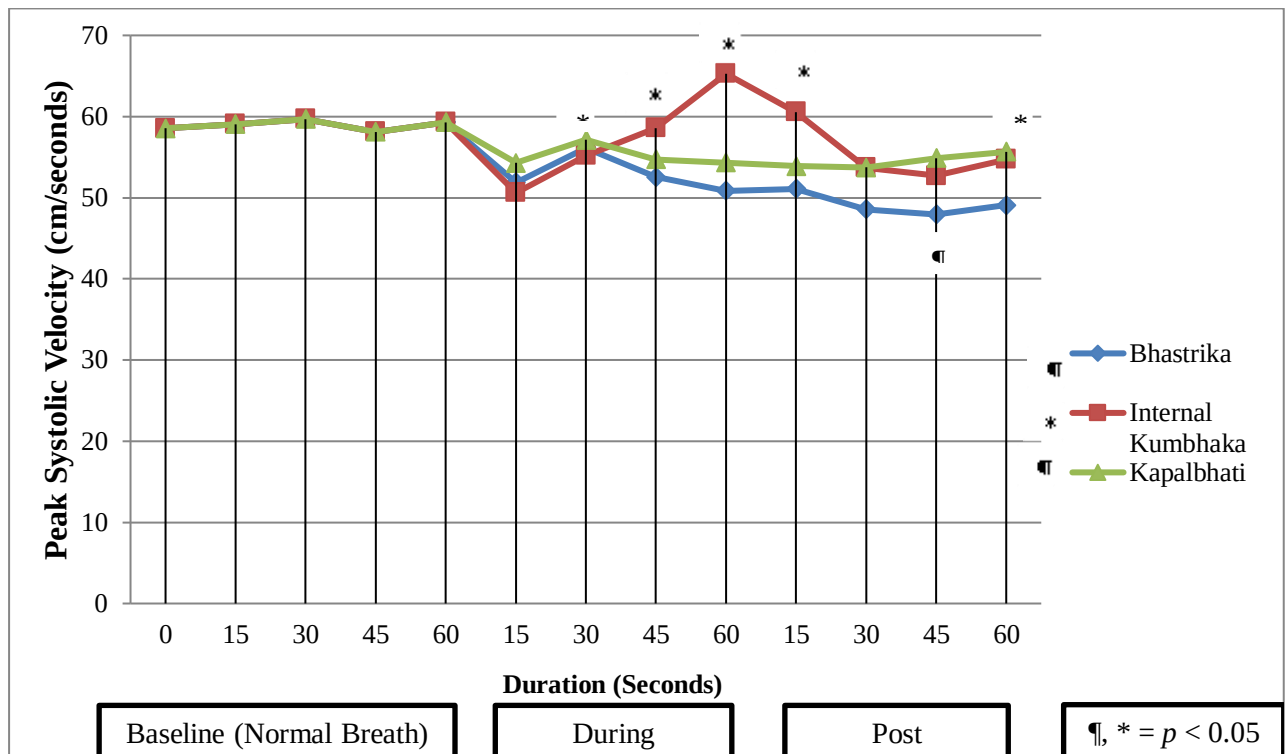


Figure 11: End Diastolic Velocity (cm/seconds) before, during and post *Bhastrika*, Internal Kumbhaka & Kapalbhata

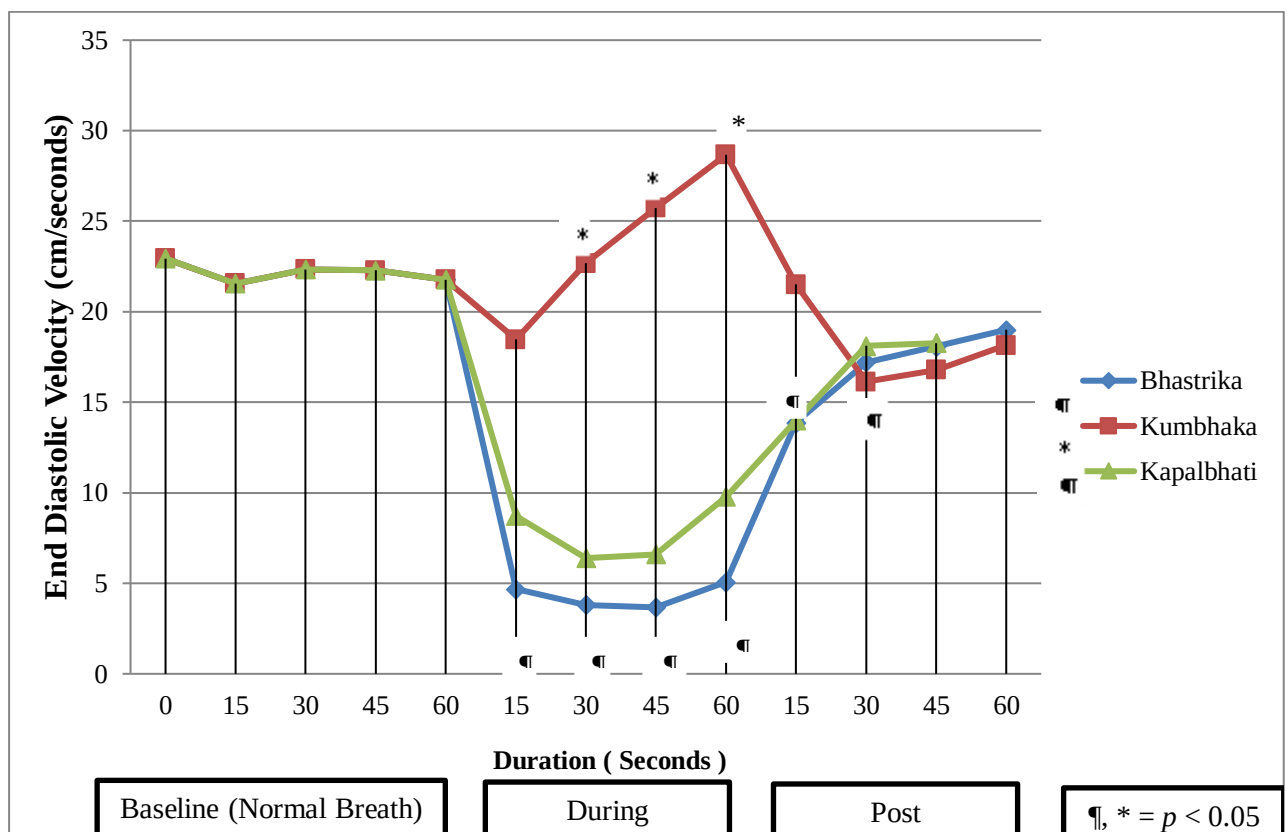


Figure 12: Mean Flow Velocity (cm/seconds) before, during and post *Bhastrika*, Internal *Kumbhaka* & *Kapalbhati*

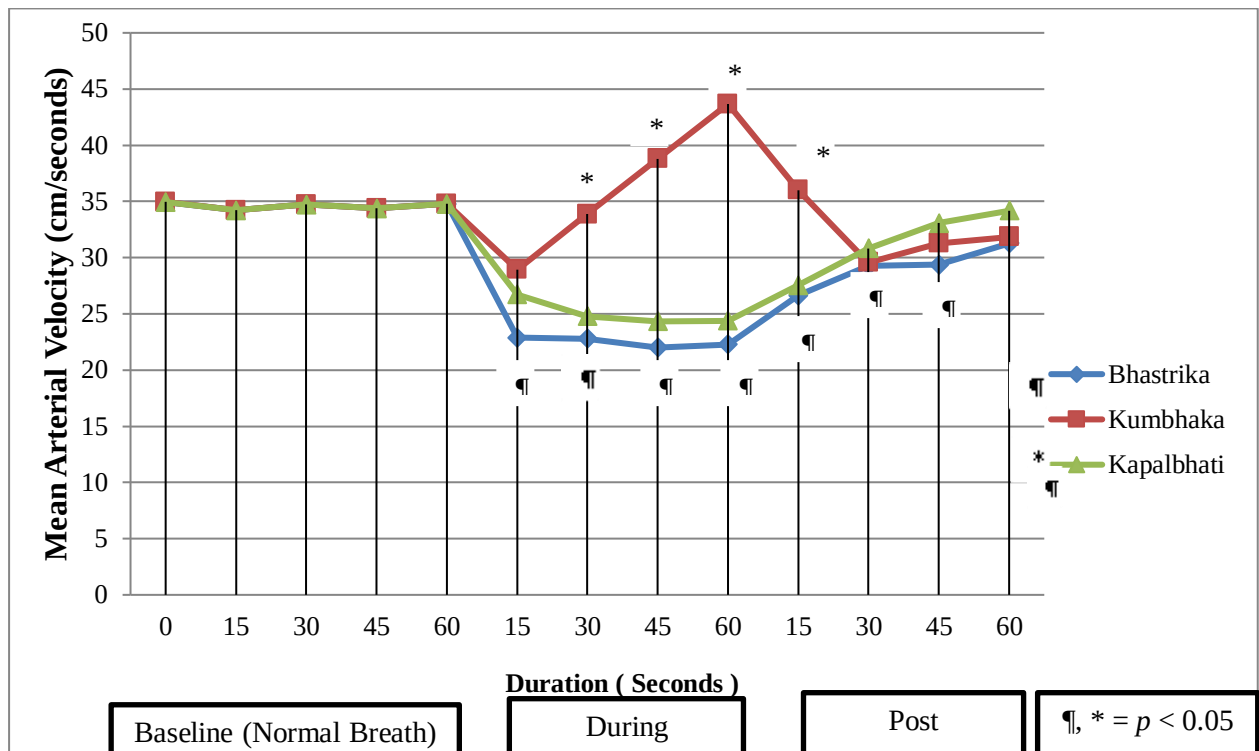


Figure 13: Pulsatility Index before, during and post *Bhastrika*, Internal *Kumbhaka* & *Kapalbhati*

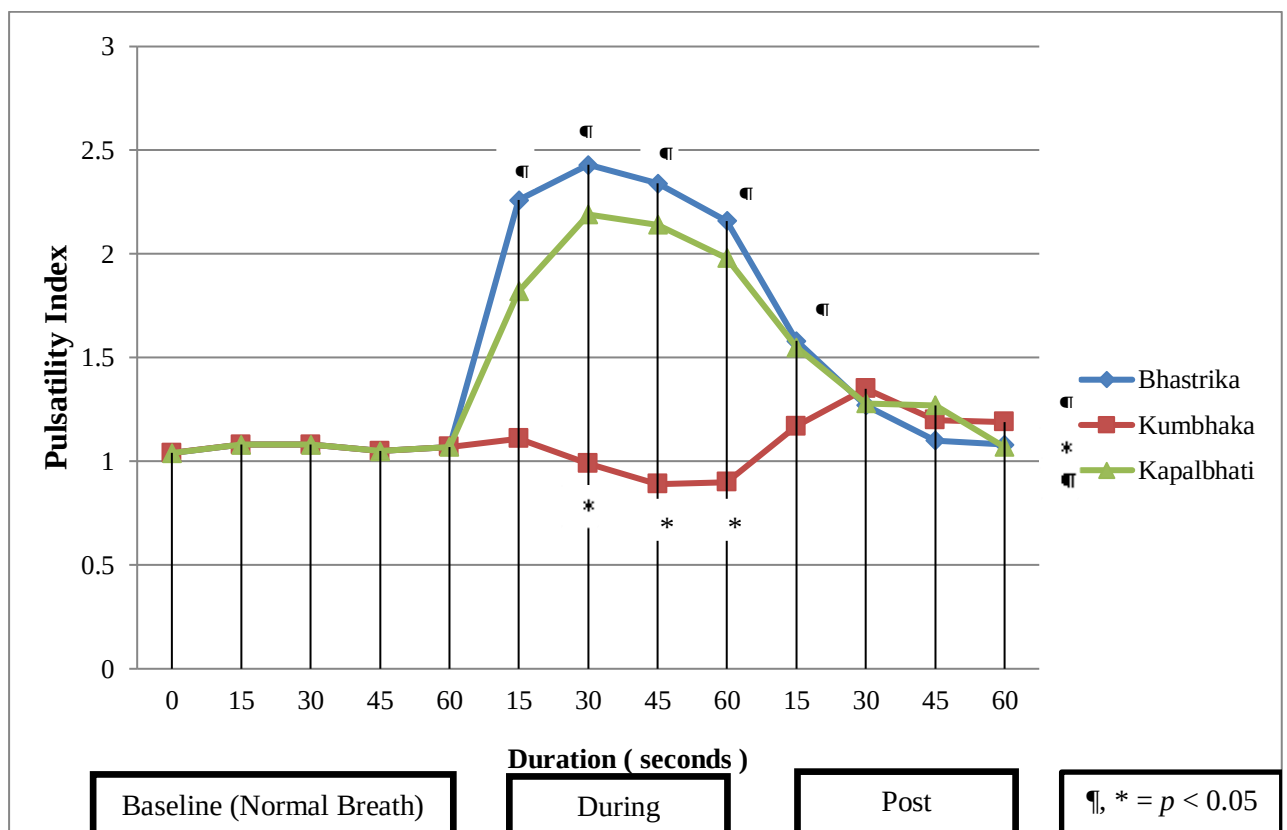


Figure 14: Peak Systolic Velocity (cm/seconds) before, during and after *Bhramari* Pranayama

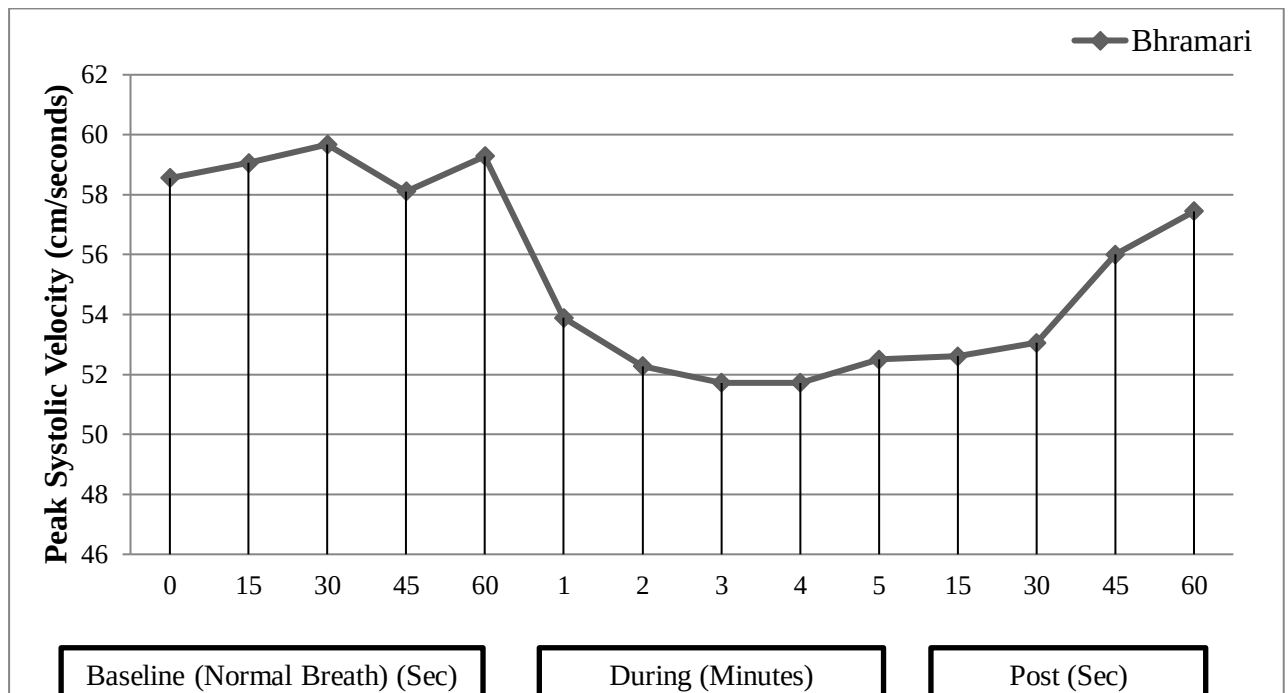


Figure 15: End Diastolic Velocity (cm/seconds) before, during and after *Bhramari* Pranayama

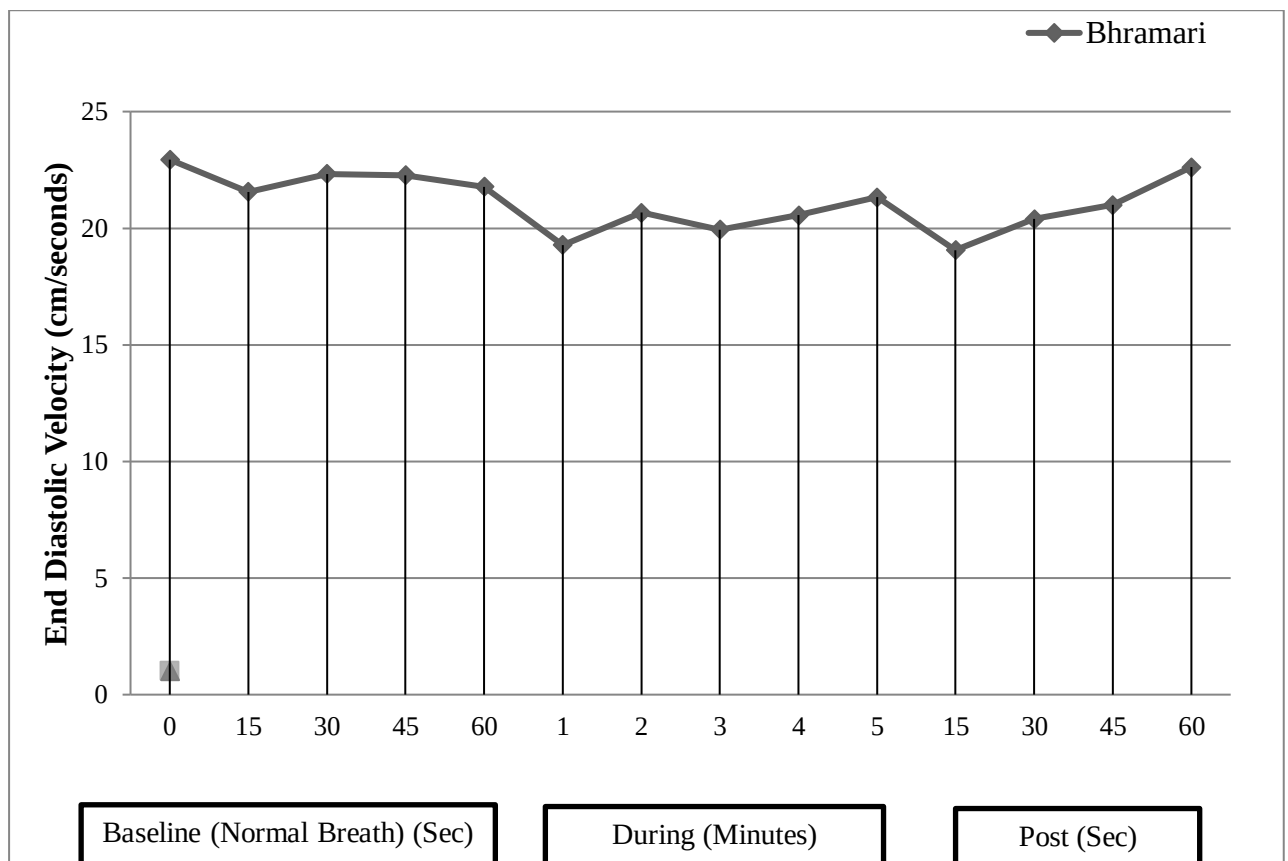


Figure 16: Mean Flow Velocity (cm/seconds) before, during and after *Bhramari Pranayama*

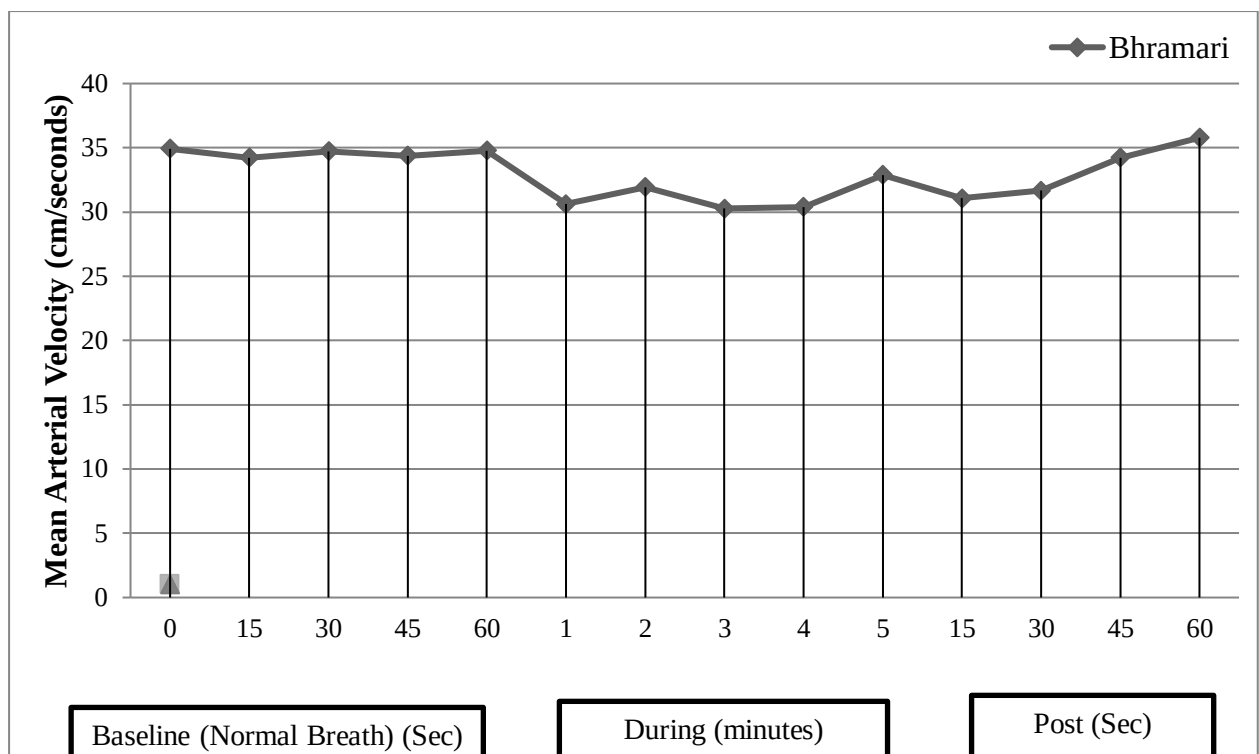


Figure 17: Pulsatility Index before, during and after *Bhramari Pranayama*

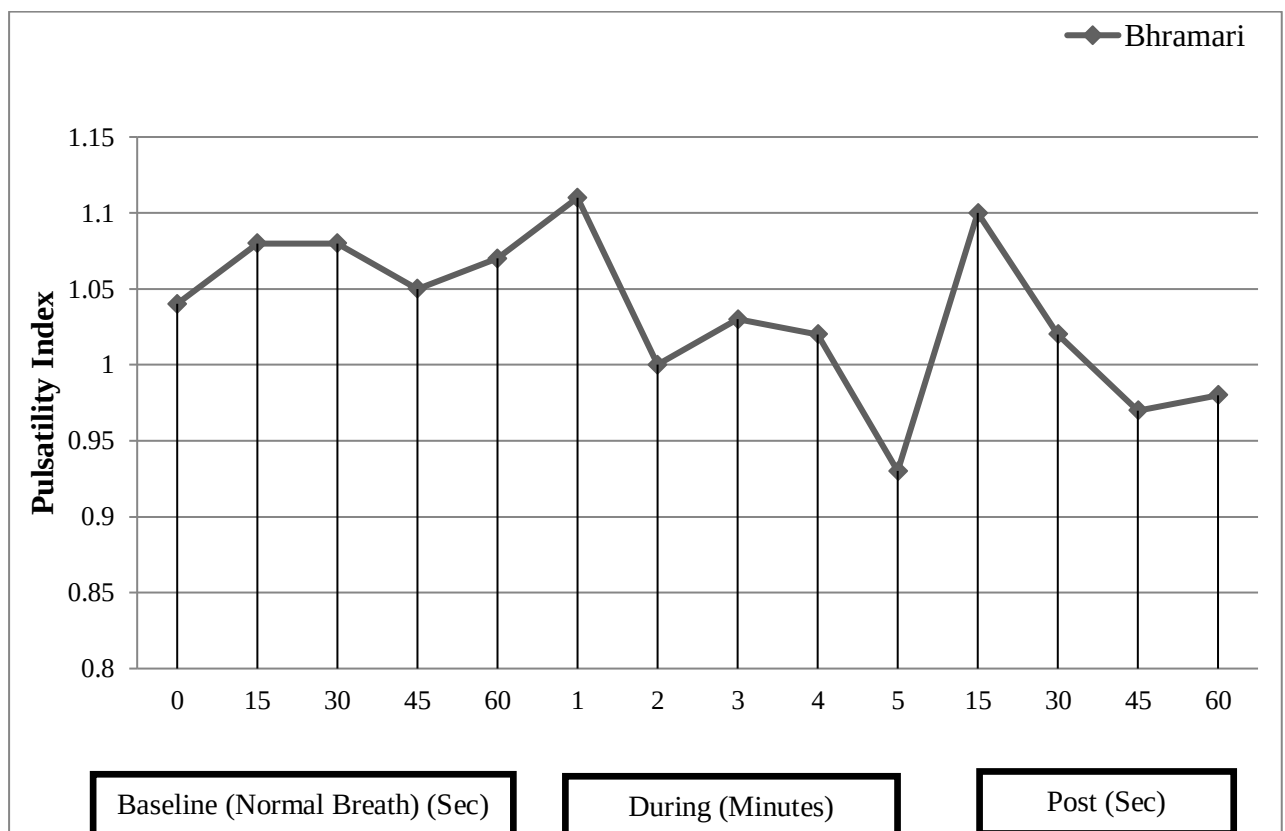


Figure 18: Peak Systolic Velocity (cm/seconds) before, during and after External *Kumbhaka*

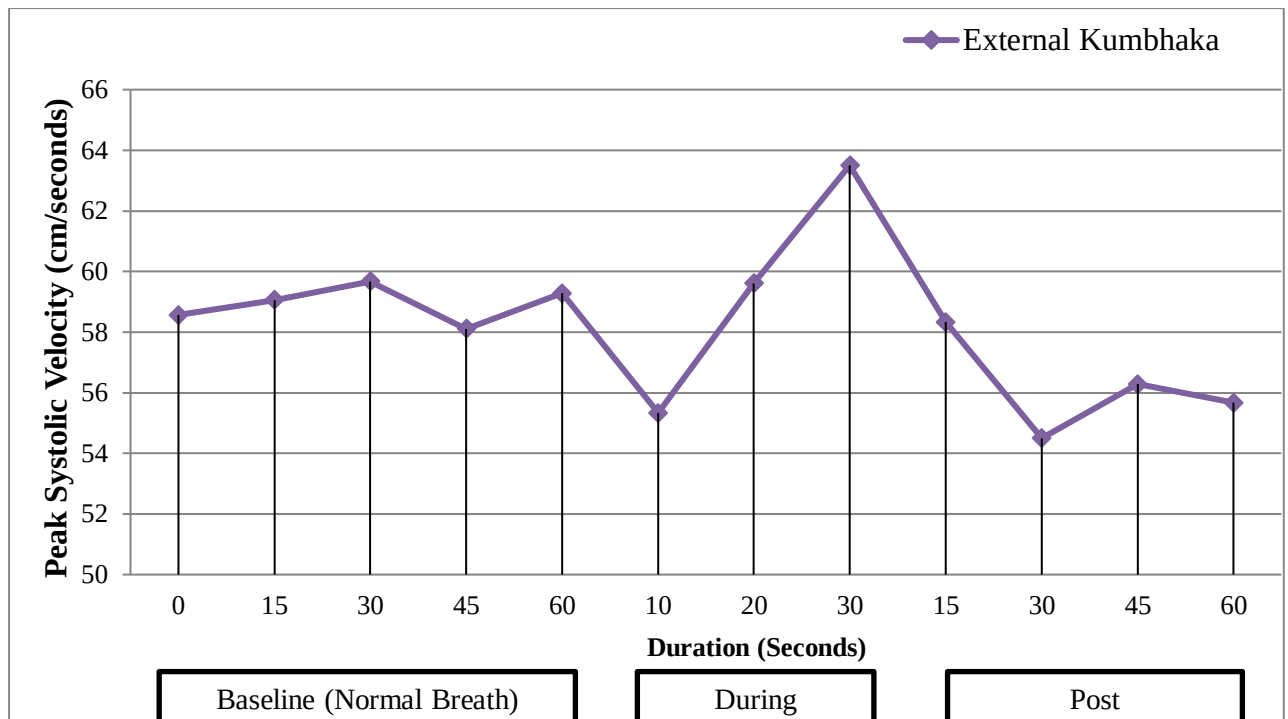


Figure 19: End Diastolic Velocity (cm/seconds) before, during and after External *Kumbhaka*

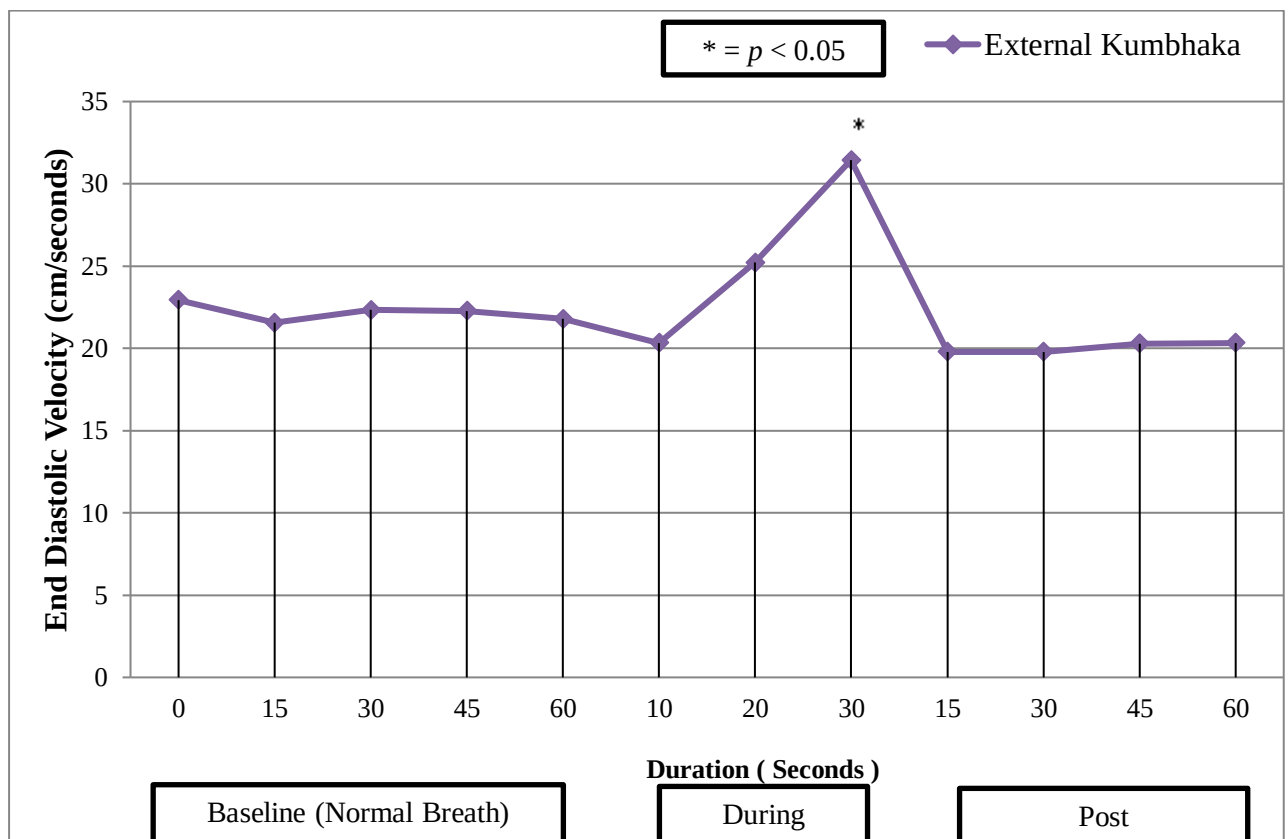


Figure 20: Mean Flow Velocity (cm/seconds) before, during and after External *Kumbhaka*

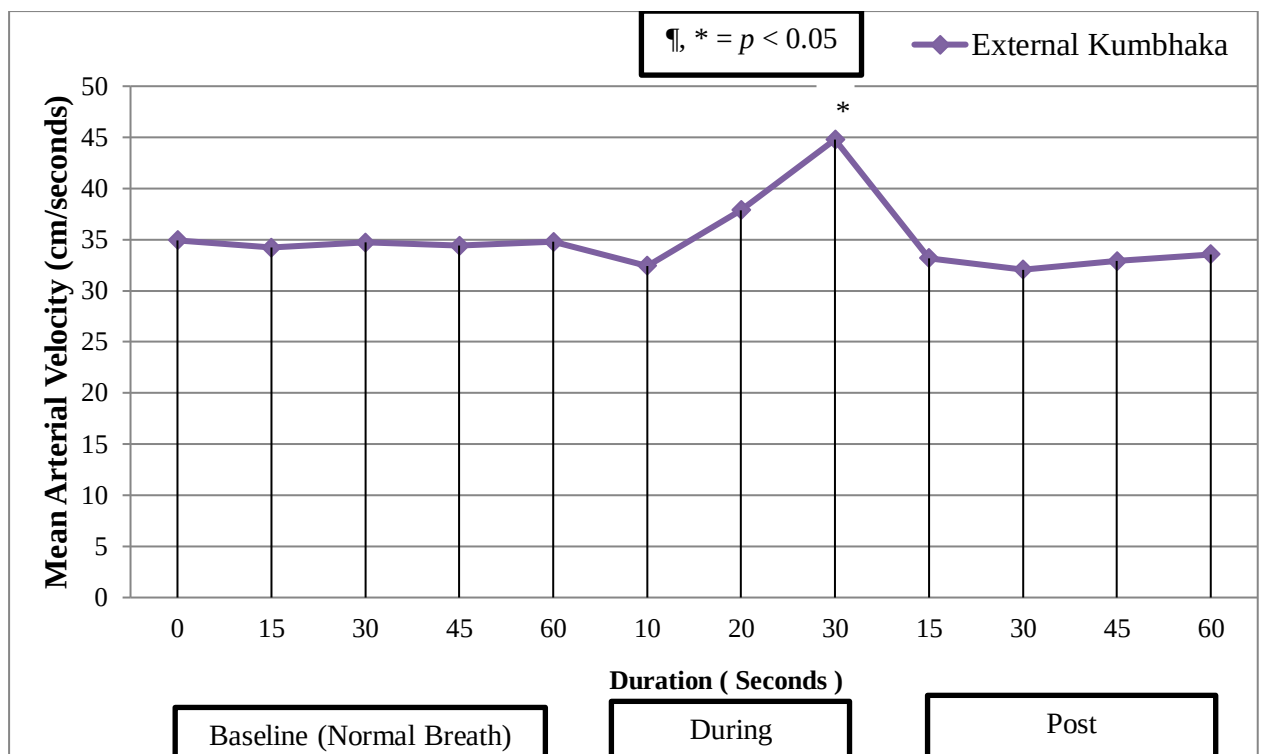
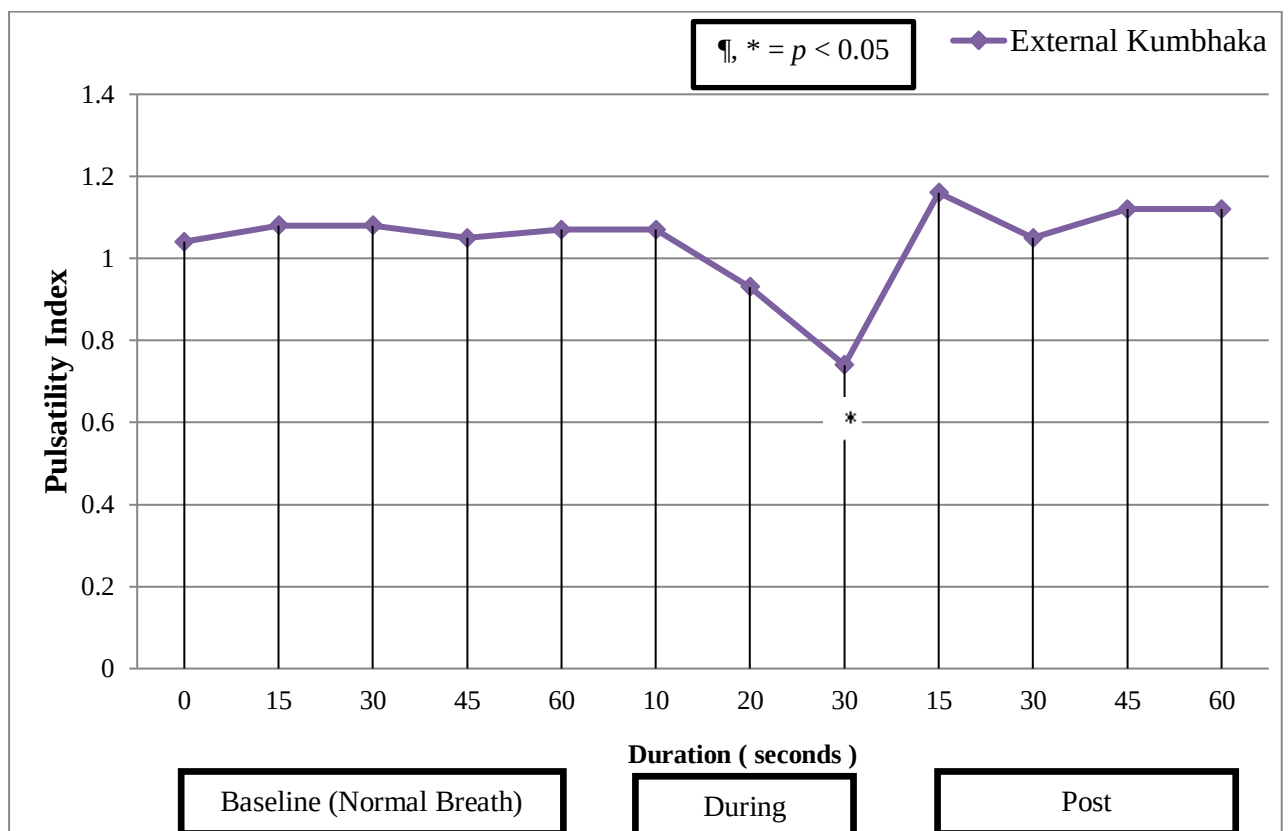


Figure 21: Pulsatility Index before, during and after External *Kumbhaka*



6.5 Cardiovascular functions during Various Pranayama Techniques & a Yogic Kriya:

Bhastrika:

The Repeated Measures ANOVA, where Mauchly's sphericity was assumed, showed significant changes within subjects between time points for SBP [$F(2, 38) = 4.015, p = 0.026$], DBP [$F(2, 38) = 8.468, p = 0.001$], MAP [$F(2, 38) = 7.141, p = 0.002$], HR [$F(2, 38) = 81.826, p < 0.001$], PI [$F(2, 38) = 44.535, p < 0.001$]. The Repeated Measures ANOVA, where Mauchly's sphericity was violated, hence Greenhouse-Geisser correction was applied to df, showed a significant change in CO [$F(1.223, 23.230) = 29.415, p < 0.001$]. Post-hoc analysis using Bonferroni corrections revealed that during the practice, a significant increase in DBP, MAP, HR, and CO along with a reduction in PI was observed. In recovery period, the increase in DBP, MAP, and HR along with a reduction in PI was sustained.

Kapalbhati:

The Repeated Measures ANOVA, where Mauchly's sphericity was assumed, showed significant changes within subjects between time points for, HR [$F(2, 38) = 56.754, p < 0.001$], SV [$F(2, 38) = 6.423, p = 0.004$], LVET [$F(2, 38) = 7.791, p = 0.001$], CO [$F(2, 38) = 40.217, p < 0.001$], PI [$F(2, 38) = 40.098, p < 0.001$]. The Repeated Measures ANOVA, where Mauchly's sphericity was violated, hence Greenhouse-Geisser correction was applied to df, showed a significant change in SBP [$F(1.476, 28.044) = 8.197, p = 0.003$], DBP [$F(1.424, 27.056) = 12.697, p < 0.001$], MAP [$F(1.447, 27.486) = 15.130, p < 0.001$]. Post-hoc analysis using Bonferroni corrections revealed that during the practice, a significant increase in SBP, DBP, MAP, HR and CO with a reduction in PI was observed. In recovery period, the increase in DBP and HR along with a reduction in PI was sustained.

Internal Kumbhaka:

The Repeated Measures ANOVA, where Mauchly's sphericity was assumed, showed significant changes within subjects between time points for, SV [$F(2, 38) = 12.075$, $p < 0.001$], CO [$F(2, 38) = 17.762$, $p < 0.001$]. The Repeated Measures ANOVA, where Mauchly's sphericity was violated, hence Greenhouse-Geisser correction was applied to df, showed a significant change in SBP [$F(1.347, 25.596) = 6.040$, $p = 0.014$], DBP [$F(1.458, 27.693) = 33.580$, $p < 0.001$]. Post-hoc analysis using Bonferroni corrections revealed that during the practice, a significant increase in SBP, DBP, MAP, and PR with a reduction in SV and CO was observed. In recovery period, the increase in MAP was sustained while rest of the variables reverts back to normal.

External Kumbhaka:

The Repeated Measures ANOVA, where Mauchly's sphericity was assumed, showed significant changes within subjects between time points for, SBP [$F(2, 38) = 17.701$, $p < 0.001$], DBP [$F(2, 38) = 27.140$, $p < 0.001$], and MAP [$F(2, 38) = 25.447$, $p < 0.001$]. Post-hoc analysis using Bonferroni corrections revealed that during the practice, a significant increase in SBP, DBP, and MAP was observed. In recovery period, the increase in DBP, and MAP was sustained while rest of the variables reverts back to normal.

Bhramari:

The Repeated Measures ANOVA, where Mauchly's sphericity was assumed, showed significant changes within subjects between time points for, DBP [$F(2, 38) = 34.798$, $p < 0.001$], MAP [$F(2, 38) = 23.640$, $p < 0.001$], HR [$F(2, 38) = 12.983$, $p < 0.001$], LVET [$F(2, 38) = 6.765$, $p = 0.003$], PI [$F(2, 38) = 11.333$, $p < 0.001$], PR [$F(2, 38) = 11.432$, $p < 0.001$]. The Repeated Measures ANOVA, where Mauchly's sphericity was violated, hence

Greenhouse-Geisser correction was applied to df, showed a significant change in SBP [$F(1.502, 28.532) = 12.470, p < 0.001$], SV [$F(1.492, 28.341) = 19.244, p < 0.001$], CO [$F(1.545, 29.361) = 10.836, p = 0.001$]. Post-hoc analysis using Bonferroni corrections revealed that during the practice, a significant increase in DBP, MAP, HR, and PR with a reduction in SV, CO and PI was observed. In recovery period, the reduction in SV and CO was sustained while rest of the variables reverts back to normal (Table 14).

Table 14: Cardiovascular functions during *Pranayama* Techniques & a *Yogic Kriya* (RMANOVA with *Post hoc* analysis and *Bonferroni* corrections)

		SBP (mmHg)	DBP (mmHg)	MAP (mmHg)	HR (beats/mint)	SV (l/Sec)	LVET (msc)	Cardiac output (l/mint)	Pulse Interval	PR (Medical Unit)
Baseline		115.03±14.54	70.82±9.23	87.91±10.64	83.97±10.91	70.29±13.00	269.39±17.93	5.84±1.23	735.84±98.40	1.03±0.28
<i>Bhastrika</i>	During	119.50±14.14	74.91±9.23*	91.99±10.69*	114.20±13.92*	66.46±12.05	262.12±17.66	7.50±1.58*	570.27±80.90*	0.97±0.29
	Post	122.06±14.11	77.31±10.88*	94.61±12.12*	93.74±14.80*	63.99±9.90	259.72±21.71	5.95±1.26	679.75±114.09*	1.13±0.38
<i>Bhramari</i>	During	119.82±15.17	78.40±10.67*	94.34±11.72*	92.40±11.28*	58.25±8.94*	255.30±23.15*	5.30±1.06*	673.11±81.04*	1.23±0.36*
	post	111.98±13.82	72.11±8.79	88.08±9.90	86.45±12.47	62.48±9.93*	258.47±14.87*	5.34±1.08*	719.30±106.70	1.12±0.40
<i>Kapalbhati</i>	During	123.81±12.97*	76.73±8.89*	96.03±10.31*	106.90±13.01*	71.27±12.39	268.46±11.94	7.58±1.79*	592.33±76.40*	1.00±0.30
	Post	116.97±12.96	75.23±8.30*	91.68±9.26	92.01±11.32*	63.61±11.15	257.36±18.31*	5.78±1.12	676.74±91.34*	1.07±0.31
<i>Internal Kumbhaka</i>	During	126.47±18.60*	82.44±8.98*	99.54±12.51*	88.75±11.47	59.43±16.24*	264.20±30.65	5.15±1.39*	698.56±93.99	1.31±0.37*
	Post	120.05±11.40	73.26±8.03	91.95±8.71*	85.77±11.43	73.02±10.89	265.49±18.01	6.19±1.16	728.46±114.98	1.13±0.83

<i>External</i>	During	128.27±18.51*	80.13±11.27*	99.27±13.85*	86.93±14.09	70.19±12.06	261.25±21.65	6.02±1.38	721.60±136.32	1.11±0.30
<i>Kumbhaka</i>	Post	119.02±12.60	73.63±8.74*	91.54±9.77*	86.07±12.12	70.29±12.69	263.26±19.27	5.96±1.13	723.11±116.55	1.01±0.26
Note: All values are in Mean ± Standard Deviation. * = p<0.05. RMANOVA = Repeated measures of analysis of variance; SBP = Systolic blood pressure; DBP = Diastolic blood pressure; MAP = Mean arterial pressure; HR = Heart rate; SV = Stroke volume; LVFT = Left ventricular ejection time; PR = Peripheral resistant										

Figure 22: Changes in Systolic Blood Pressure during *Pranayama* Techniques & a *Yogic Kriya*

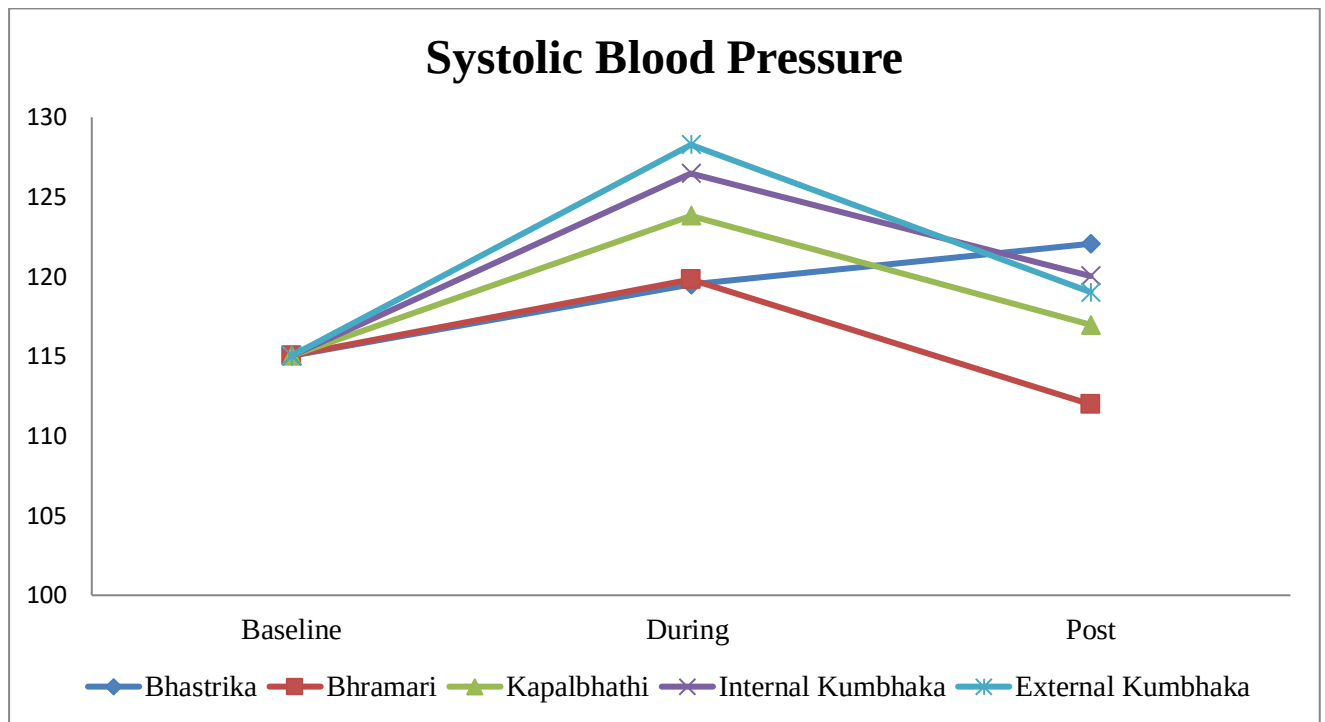


Figure 23: Changes in Diastolic Blood Pressure during *Pranayama* Techniques & a *Yogic Kriya*

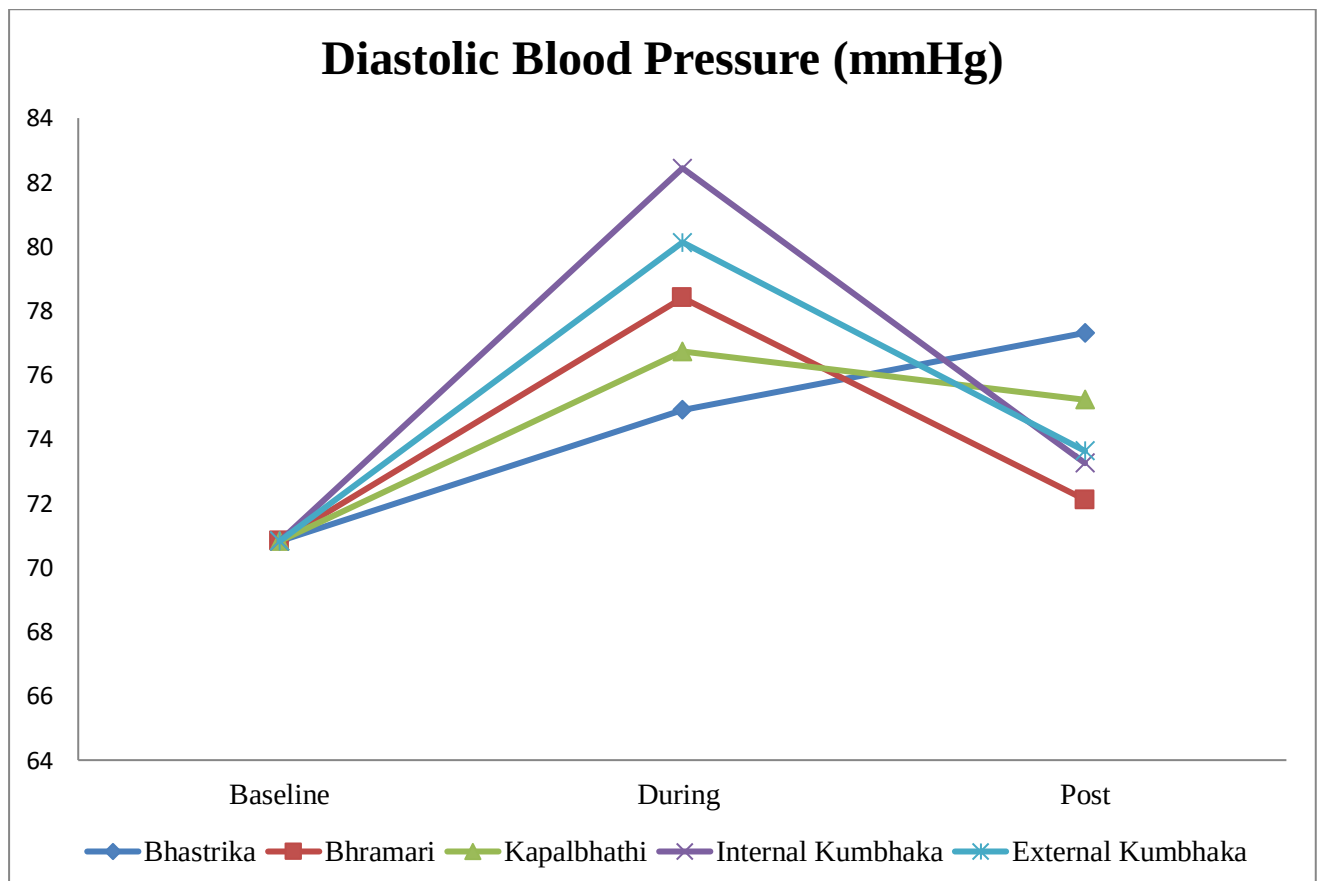


Figure 24: Changes in Mean Arterial Pressure during *Pranayama* Techniques & a *Yogic Kriya*

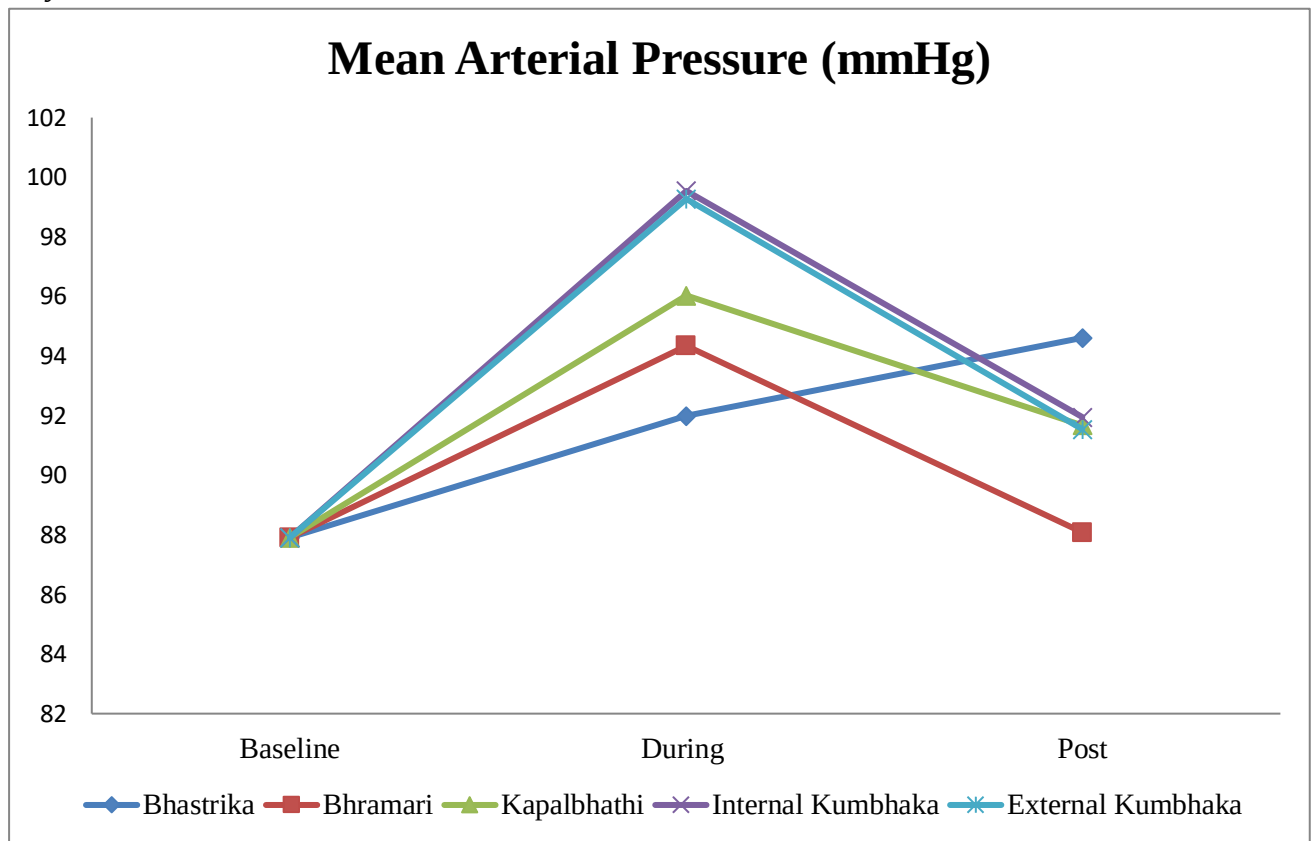


Figure 25: Changes in Heart Rate during *Pranayama* Techniques & a *Yogic Kriya*

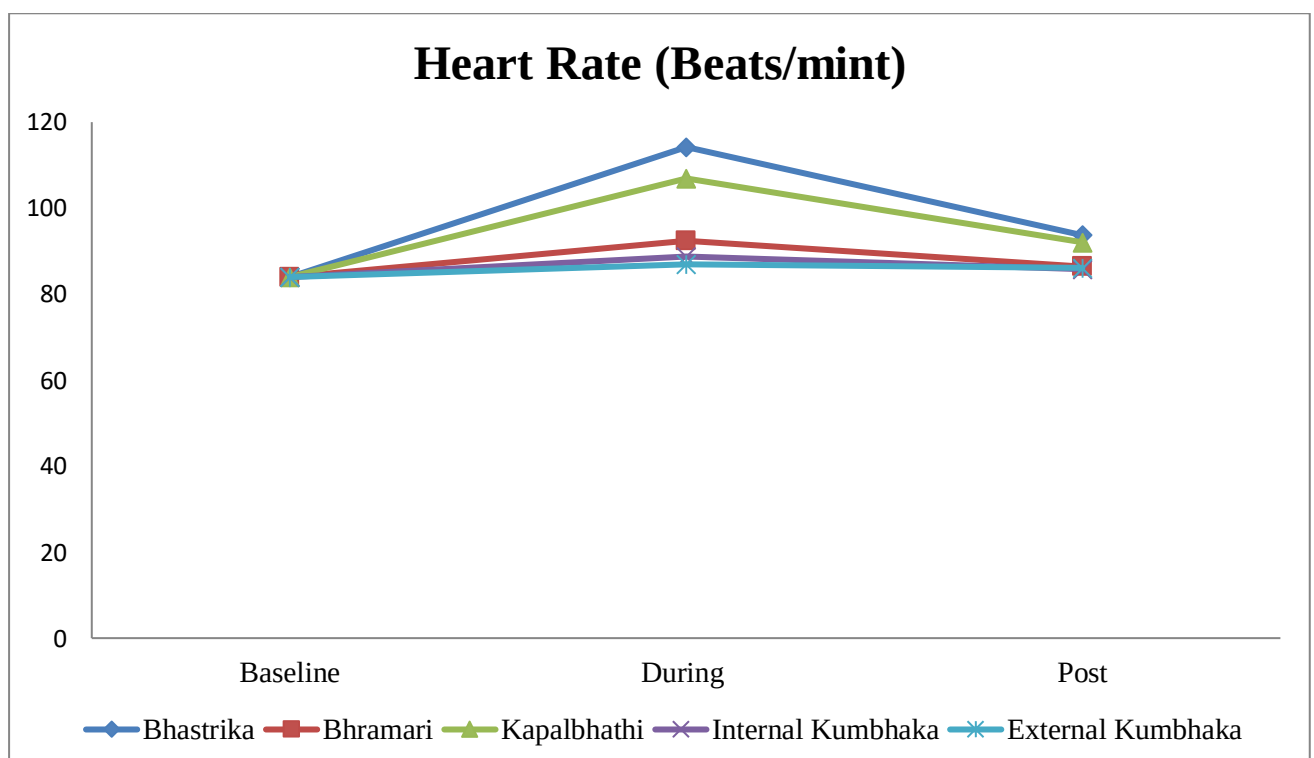


Figure 26: Changes in Stroke Volume during *Pranayama* Techniques & a *Yogic Kriya*

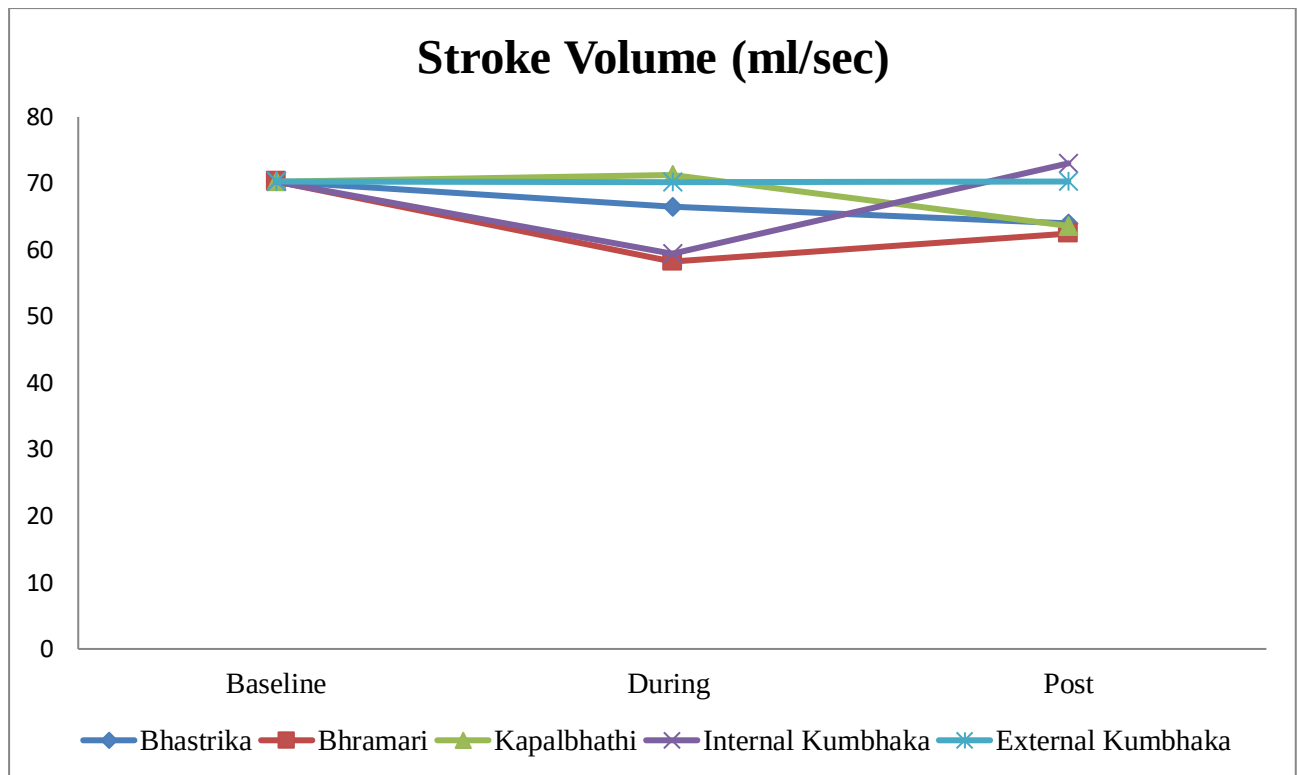


Figure 27: Changes in Cardiac Output during *Pranayama* Techniques & a *Yogic Kriya*

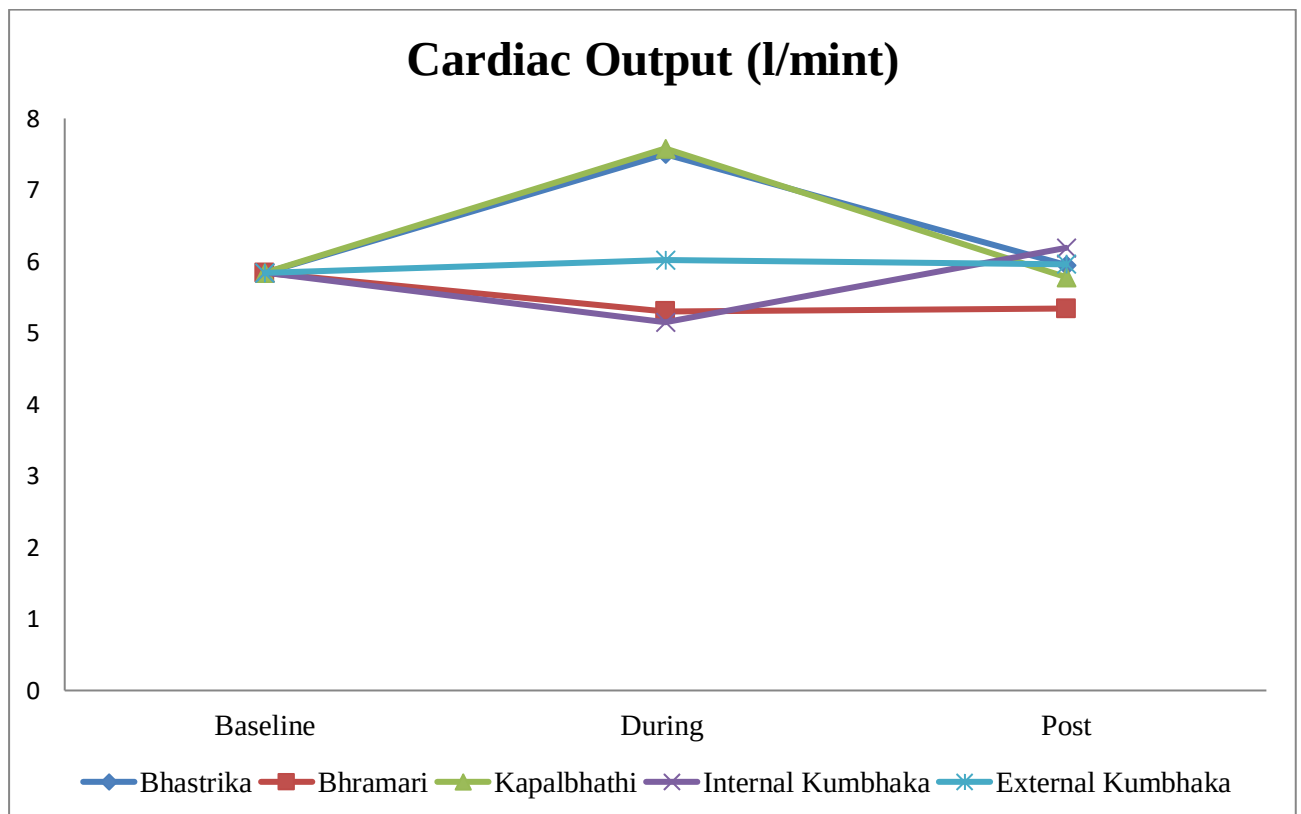


Figure 28: Changes in Pulse Interval during *Pranayama* Techniques & a *Yogic Kriya*

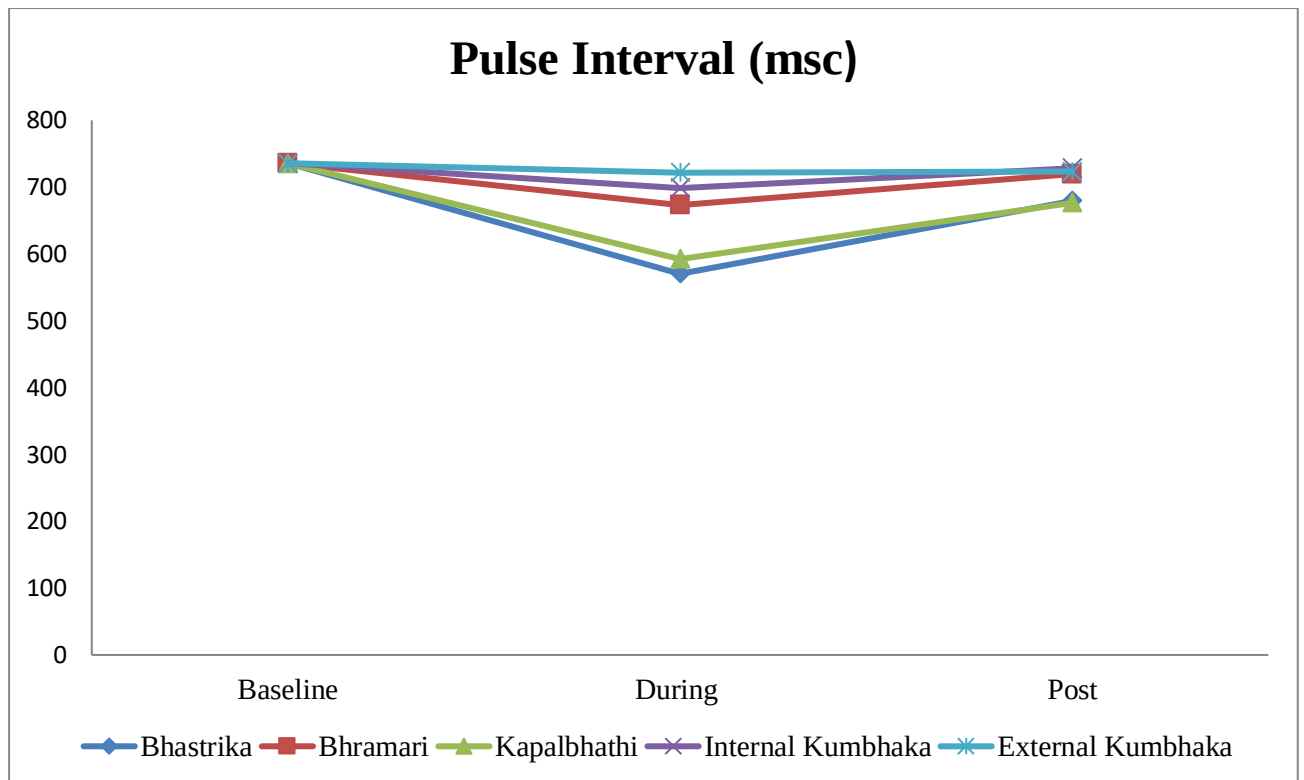


Figure 29: Changes in Peripheral Resistant during Various *Pranayama* Techniques & a *Yogic Kriya*

