

DETERMINATION OF CARDIAC OUTPUT IN MEDICAL STUDENTS BY PULSE PRESSURE METHOD

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Background: Since stroke volume is the work that heart performs in each heart beat and cardiac output (COP) is expressed as product of stroke volume and heart rate. Pulse pressure is determined approximately by the ratio of stroke volume output to the compliance of arterial tree. We hypothesized that by simply determining pulse pressure COP can be measured and these observations were made before and after moderate exercise in male and female medical students. **Methods:** Male students (n=15) and female students (n=21) belonging to age group 18–25 years weighing 40–65 kg, having no cardiovascular ailment were included in the study. Blood pressure, pulse pressure and heart rate were determined. Hemoglobin estimations were done. **Results:** There was a significant increase in pulse pressure and hence cardiac output in males and females after exercise. It was more significant in females. COP before exercise in females was 2.90 ± 0.17 L/min ($p < 0.001$) after exercise 3.42 ± 0.70 L/min. In male students the COP results were 3.30 ± 0.20 L/min and 3.90 ± 0.20 L/min before and after exercise respectively with $p < 0.05$. Our results correspond with standard cardiac output evaluation for these age groups. **Conclusion:** We conclude that pulse pressure is a good predictor for cardiac output evaluation

Keywords: Cardiac output, stroke volume, exercise

INTRODUCTION

The measurement of pulse pressure is the difference of the two blood pressure measurements i.e. systolic and diastolic. It is in a range of 30–40 mmHg.¹ High pulse pressure (greater than 40 mmHg) suggests pathophysiology in isolated systolic hypertension.² Narrowed pulse pressure less than 30 mmHg could be due to tachycardia, severe aortic stenosis, constrictive pericarditis, pericardial effusion, ascites. Cardiac output is a product of stroke volume and heart rate where as pulse pressure is determined approximately by the ratio of stroke volume output to compliance of the arterial tree.³

As the left ventricle ejects blood into the aorta, the aortic pressure increases. The greater the stroke volume, the greater the change in pressure during ejection. The rise in aortic pressure from its diastolic to systolic value is determined by compliance of aorta as well as ventricular stroke volume.⁴

This study was designed in order to find a relationship between pulse pressure and cardiac output and to observe the effect of exercise on cardiac output and pulse pressure

MATERIAL AND METHODS

The study included medical students from Fatima Jinnah Medical College and Allama Iqbal Medical College (females=21, males=15) in age group of 18–25 years weighing 40–65 kg socio-economically matched with no history of cardiovascular ailment.

Blood pressure of students was measured before and after exercise, pulse pressure was calculated and heart rate counted. We made sure that

students were not suffering from anaemia so Hb count was determined by Sahli's Method and none of them turned out to be anaemic.

RESULTS

Table-1 shows comparison of pulse pressure and cardiac output before and after exercise in female subjects. A significant correlation at $P < 0.001$ was found. Table 2 shows Cardiac output and pulse pressure before and after exercise in male medical students is represented. They also showed in comparison, significant results. Table-3 and 4 give comparison between male and female students before and after exercise of pulse pressure and cardiac output is represented. A significant difference was found in results with $p < 0.05$.

Table-1: Comparison of pulse pressure and Cardiac Output in female students before and after Exercise

	Before Exercise (n=21)	After Exercise (n=21)
Pulse Pressure (mmHg)	37.81 ± 1.70	$41.2 \pm 0.40^*$
Cardiac output (lit/min)	2.9 ± 0.30	$3.42 \pm 0.70^*$

* $p < 0.001$

DISCUSSION

There is a certain force, which facilitates the maintenance of circulation of blood in our body called blood pressure. Systolic pressure is highest arterial pressure of a cardiac cycle that occurs immediately after contraction of left ventricle of

heart.⁵ Diastolic pressure is lowest arterial blood pressure of a cardiac cycle occurring during expansion or dilatation of cavities of heart during which they fill with blood. Difference between the two is pulse pressure.⁶ The two major factors effecting pulse pressure are stroke volume output of heart, and compliance of arterial tree.

Table-2: Comparison of pulse pressure and Cardiac output in male students before and after Exercise

	Before Exercise (n=15)	After Exercise (n=15)
Pulse pressure (mm Hg)	43.2± 0.76	44.0 ± 0.17*
Cardiac Output (L/min)	3.3 ± 0.20	3.9 ±0.25*

*p<0.05

Table-3: Comparison of pulse pressure and Cardiac Output in between male and female students before exercise

	Females (n=21)	Males (n=15)
Pulse pressure (mm Hg)	37. 81 ± 1.7	43.2 ± 0.76*
Cardiac Output (L/min)	2.90±0.30	3.30±0.20*

*p<0.05

Table-4: Comparison of pulse pressure and Cardiac Output in between male and female students after exercise (Results expressed as mean ± standard deviation)

	Females (n=21)	Males (n= 15)
Pulse pressure (mmHg)	41.2 ± 0. 40	44.0 ± 0. 17*
Cardiac Output (L/min)	3.42±0.70	3.9±0.25*

*p<0.05

According to a study, 10 mm Hg wider pulse pressure increased the risk of major cardiovascular complications. Increase in risk range

from approximately 13% for all coronary end points to nearly 20% for cardiovascular mortality.⁷

Considering the importance, pulse pressure and cardiac output are studied showing a positive correlation between cardiac output and pulse pressure before and after exercise between two groups.⁸ Our results correspond with standard cardiac output evaluation for these age groups.⁹

Conclusion

We conclude that pulse pressure is a good predictor for cardiac output evaluations. The positive response of cardiac output and pulse pressure in females is more after exercise. We suggest that more studies should be taken on wider group of people to support this hypothesis.

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