

# COMPARISON OF BLOOD PRESSURE INDICES (MEAN ARTERIAL PRESSURE AND PULSE PRESSURE) AFTER INDUCTION OF STRESS BETWEEN POST-COVID-19 AND HEALTHY ADULTS

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## ABSTRACT

**Objectives:** This study aimed to compute the effect of stress 6-minute Walk Test (6-MWT)/Exercise) on Blood Pressure Indices (BPIs) in both COVID-19 patients and Controls.

**Materials and Methods:** A total of 122 young adults were included in this research with 61 participants each in the cases and the controls group. Participants between the ages of 18-40 with a previously positive confirmed PCR report covid (>3 months had passed after resolution of COVID-19 infection) were included as cases while healthy adults who did not contract covid were included in the control group. All the participants from both groups were stressed by asking them to perform the 6MWT. The subject's blood pressure was checked both before and after the stress and their MAP and PP were calculated.

**Results:** In both pre and post-stress comparisons between cases and controls there was no significant difference between MAP (Post-Stress  $p=1$  and Pre-Stress  $p=0.25$ ) and PP (Post-Stress  $p=0.129$  and Pre-Stress  $p=0.68$ ). Matrix Scatter Plot between variables both pre and post-stress shows that all the variables (MAP, PP, and HR) did not correlate with each other.

**Conclusion:** BPI i.e., MAP and PP show no significant difference between post-COVID participants and healthy adults after induction of stress.

**Keywords:** Six Minute Walk Test; Covid-19; Mean Arterial Pressure; Pulse Pressure

**This article may be cited as:** Raza SS, Khan NW, Fida N, Zafar U, Ali DES, Shah A. Comparison of blood pressure indices (mean arterial pressure and pulse pressure) after induction of stress between post-COVID-19 and healthy adults. *J Med Sci* 2023 October;31(4):315-318

## INTRODUCTION

Coronavirus disease 2019 (COVID-19) spread like hay fire resulting in both morbidity and mortality. <sup>1</sup> The COVID-19 pandemic has had a significant impact on the cardiovascular system (CVS) of individuals infected with the virus. MAP and PP are important indicators of cardiovascular health and have been studied in COVID-19 patients in comparison to healthy adults. BP is also an integral part of any formula that predicts cardiovascular risk. <sup>2-8</sup> It has not been certain as to which BPI is considered

more reliable and important in evaluating the risk factor for developing cardiovascular events. The focus has more recently been on MAP and PP. <sup>9-11</sup>

MAP is the estimate of mean pressure in the arterial vasculature during one cardiac cycle. Whereas PP is the difference of systolic minus the diastolic BP i.e., the pressure exerted by the heart in the arterial tree per heartbeat. It is noteworthy here that COVID-19-infected individuals show decreased MAP and raised PP levels when compared to healthy adults. Thus, indicating a potential of cardiovascular risk linked to the condition (COVID-19). <sup>12</sup>

The six-minute walk test (6MWT) is a very simple way of giving physiological stress. It is a very safe and well-established self-paced assessment tool to gauge the physiological exercise capacity of individuals having cardiorespiratory illnesses. <sup>13</sup> The test is performed by asking the subject/patient to walk on a flat surface as swiftly as possible but without running.

This research was undertaken to examine the

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**Date Received:** 29/05/2023

**Date Revised:** 28/08/2023

**Date Accepted:** 20/10/2023

differences in MAP and PP in both COVID patients and Controls both before and after stress via the 6MWT or Exercise. This comparison between the indices pre and post-stress led us to determine the effects of COVID-19 on CVS. Remedies can be developed once we have established the effects of COVID-19 infection on BPIs. This research aims to assess the effect of the 6-minute walk test on blood pressure indices (MAP and PP), between healthy and post covid young adults of Khyber Pakhtunkhwa.

**MATERIALS & METHODS**

The study was carried out in the Dept. of Physiology at the Khyber Medical College from July 2021 to December 2021 after seeking approval from the Institutional Review & Ethics Board of Khyber Medical University. A total of 122 young adults were included in this research with 61 participants each in the cases and the control group.

The sample size was estimated using the G\* Power equation. The statistical test adopted was: the difference between two independent means, test family was t test. A priori analysis was performed by keeping power at 95% (1-β) and 5% margin of error. Effect size of 0.6. Allocation ratio of 1.

Adults between the ages of 18-40 with a previously positive confirmed PCR report covid (>3 months had passed after resolution of COVID-19 infection) were included as cases while healthy adults that did not contract covid were included in the control group.

Participants with cardiovascular comorbid were removed from the study population. Similarly, smokers and athletes were also excluded. The participants consented to take part in the study.

All the participants from both groups were stressed by asking them to perform the six-minute walk test. Participant’s blood pressure was checked both before and after the stress and their MAP and PP were calculated according to their respective formulas: MAP = Diastolic Blood Pressure + 1/3(Pulse Pressure) and PP = Systolic Blood Pressure (SBP

– Diastolic Blood Pressure (DBP). The variables were fed in MS Excel followed by calculation of MAP and PP. This data was then entered in the SPSS software v. 26.0. The distribution of data was checked using Shapiro-Wilk tests.

The differences in mean and standard deviation were calculated for both pre and post-stress phases followed by the application of t-test for comparison of means. A matrix scatter plot was obtained between variables to check for any correlation between them.

**RESULTS**

The mean age of cases was 27±3.8 years and that of controls was 24.1±1.92 years. In both pre and post-stress comparisons between cases and controls, there was no significant difference between MAP (Post-Stress p=1 and Pre-Stress p=0.25) and PP (Post-Stress p=0.129 and Pre-Stress p=0.68). However, HR (Post-Stress p=0.021 and Pre-Stress p=0.034) showed statistical significance (**Tables 1 and 2**).

Although the variables were statistically insignificant upon a comparison of the means, controls had a higher PP than cases in both pre and post-stress phases. Post-stress PP for controls was 42.75±10.24 mm Hg while for cases it was 39.7±11.12 mm Hg with a mean difference of -3.05 mm Hg (p=0.129). While pre-stress PP for controls was 38.66±9.84 mm Hg while for cases was 37.98±7.89 mg Hg with a mean difference of -4.86 mm Hg (p=0.68).

Controls had a slightly higher MAP than cases in the pre-stress phase. Post-stress MAP for controls was 97.61±11.84mm Hg while for cases it was 95.27±9.91 mm Hg with a mean difference of -2.33 mm Hg (p=0.25). HR was higher in controls in comparison to cases in both the pre and post-stress phases.

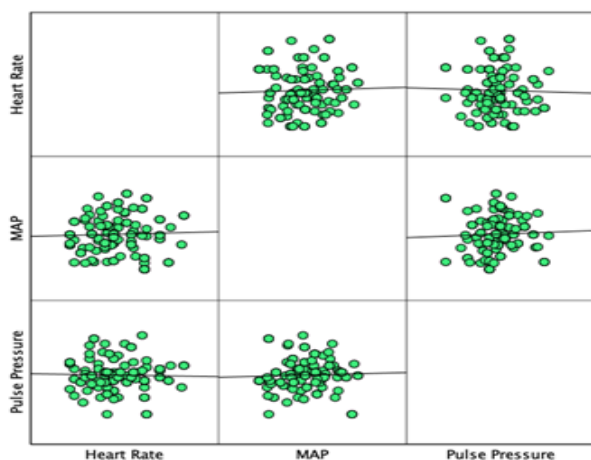
Matrix Scatter Plot between variables both pre and post-stress show that all the variables (MAP, PP, and HR) did not correlate with each other (**Figure 1**).

**Table 1: Post-testing statistics showing no statistically significant difference between Blood Pressure Indices (Mean Arterial Pressure and Pulse Pressure) of COVID cases and controls.**

	Group Statistics (Post Stress 6-MWT)				
	History of Covid Infection	Mean± Std. Deviation	Mean Difference	Sig. (2-tailed)	95% CI of the Mean Difference
Mean Arterial Pressure (MAP) DP + 1/3(PP)	Cases	98.65±13.51 mm Hg	0.00031	1	-4.76, 4.76
	Controls	98.65±12.24 mm Hg			
Pulse Pressure	Cases	39.7±11.12 mm Hg	-3.05	0.129	-6.99, 0.896
	Controls	42.75±10.24 mm Hg			
HR (Beats/Min)	Cases	96.59±18.48	8.18	0.021	-15.11, -1.25
	Controls	104.77±18.92			

**Table 1: Post-testing statistics showing no statistically significant difference between Blood Pressure Indices (Mean Arterial Pressure and Pulse Pressure) of COVID cases and controls.**

	Group Statistics (Pre-Stress 6-MWT)				
	History of Covid Infection	Mean± Std. Deviation	Mean Difference	Sig. (-2tailed)	%95 CI of the Mean Difference
Mean Arterial Pressure (MAP) DP + 1/3(PP)	Cases	9.91±95.27 mm Hg	2.33-	0.25	1.73 ,6.39-
	Controls	11.84±97.61 mm Hg			
Pulse Pressure	Cases	7.89±37.98 mm Hg	0.67-	0.68	2.65 ,3.99-
	Controls	9.84±38.66 mm Hg			
HR (Beats/Minute)	Cases	10.9±83.91	4.81-	0.034	0.37- ,9.25-
	Controls	13.11±88.72			

**Fig 1: Matrix Scatter Plot between variables post stress shows that all the variables (MAP, PP, and HR) did not correlate with each other**

## DISCUSSION

Our study is the first of its kind given the design of our study. Although the variables were statistically insignificant upon a comparison of the means, controls had a higher PP than cases in both the pre and post-stress phases. There are no studies in the literature that have checked the BPIs before and after giving stress. However, a study carried out in China found a PP of  $49.9 \pm 6.8$  mm Hg for COVID-infected individuals.<sup>14</sup> This is considerably higher in comparison to the results of our study.

The Covid group had a MAP of  $98.65 \pm 13.51$  mm Hg in the post-stress phase. This is in contrast to a study where COVID-19-affected individuals had a MAP of  $93.6 \pm 5.3$  mm Hg.<sup>14</sup> However, the readings were not checked before or after stress and there was no control group like ours. Increased sympathetic tone also occurs during exercise, severe hemorrhage, and in times of psychological stress. The combination of these events increases both cardiac output and systemic vascular resistance, effectively increasing MAP<sup>15,16</sup>. Hence, the measurement of both MAP and PP before and after stress via 6MWT was taken into account in our study.

A United States-based study reported MAP and PP between COVID-19 symptomatic patients (S), controls (CON), and COVID-19 asymptomatic patients (AS). This study included 27 participants divided equally into each group. The pre-exercise MAP was not different between the groups when taken in the sitting position (CON =  $89 \pm 6$  mm Hg; AS =  $92 \pm 3$  mm Hg; S =  $87 \pm 5$  mm Hg). The study reported no difference in MAP before or during sub-maximal treadmill exercise between groups. Significance was set to  $p < 0.05$ .<sup>17,18</sup>

The differences in MAP and PP between COVID-19 patients and healthy adults may have important clinical implications. Lower MAP and higher PP are associated with increased mortality in critically ill patients, and monitoring these values may be important in the management of COVID-19 patients.<sup>19</sup>

It is evident from the literature that COVID-19 patients have lower MAP and higher PP than healthy adults or non-COVID-19 ARDS patients. Such differences may exist due to the direct effects of the virus on CVS or the increased vascular permeability and inflammation associated with the disease. Further research is needed to fully understand the implications of these differences for the management and prognosis of COVID-19 patients.

Due to limited resources a larger study sample could not be checked for BPIs which is a limitation. No biomarkers were studied only the BPIs were checked and the differences between the two groups were audited.

## CONCLUSION

In conclusion, BPI i.e., MAP and PP show no significant difference between post-COVID-19 participants and healthy adults after induction of stress.

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**CONFLICT OF INTEREST:** Authors declare no conflict of interest

**GRANT SUPPORT AND FINANCIAL DISCLOSURE:** NIL

#### AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

- Raza SS:** Concept, critical appraisal, formatting of the article and discussion writing
- Khan NW:** Data collection, compilation of results
- Fida N:** Data collection, manuscript writing
- Zafar U:** Concept, Manuscript writing, bibliography, over all supervision
- Ali DES:** Data collection, Overall compilation of the article, manuscript writing
- Shah A:** Data collection, manuscript writing

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



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