e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2024; 16(1); 491-494

Original Research Article

Assessing the Cardiovascular Response to a Six-Week Isometric Exercise Regimen in Medical Students: An Observational Case-Control Study

Poonam Rani[1], Neera Kumari[2]

[1]Tutor, Department of Physiology, SKMCH, Muzaffarpur, Bihar, India

[2]Assistant Professor and HOD, Department of Physiology, SKMCH, Muzaffarpur, Bihar, India

Received: 13-12-2023 / Revised: 10-01-2024 / Accepted: 26-01-2024
Corresponding Author: Dr. Neera Kumari
Conflict of interest: Nil

Abstract

Aim: Investigate the cardiovascular reactions to a six-week isometric exercise regimen in first-year medical students.

Materials and Methods: This one-year case-control research was undertaken at the Department of Physiology, SKMCH, Muzaffarpur, Bihar, India, on 100 untrained first-year medical students. The Handgrip Dynamometer was used for isometric exercise. The research group attended five weekly training sessions for six weeks. Heart rate and blood pressure were measured again for the study and control groups after six weeks of training. Baseline data was measured using the same method. After training, handgrip exercise tests at 30% MVC until exhaustion were performed under the identical settings as baseline testing.

Results: The initial heart rate and blood pressure data were similar in both groups, suggesting that the groups were evenly matched at the beginning of the trial. The research group saw a drop in heart rate from an initial value of 72.3 ± 5.2 bpm to 68.1 ± 4.8 bpm, resulting in a mean change of -4.2 ± 1.9 bpm ($p < 0.001$). The systolic blood pressure reduced from 118.5 ± 8.2 mmHg to 112.3 ± 7.6 mmHg, with a mean reduction of -6.2 ± 2.4 mmHg ($p < 0.001$). Similarly, the diastolic blood pressure declined from 76.4 ± 5.1 mmHg to 71.2 ± 4.7 mmHg, with a mean decrease of -5.2 ± 2.1 mmHg ($p < 0.001$).

Conclusion: The six-week isometric exercise training programme improved cardiovascular markers in study group members, showing that such programmes may improve cardiovascular health.

Keywords: Blood Pressure, Cardiovascular responses, Handgrip dynamometer, Isometric exercise, Medical students, Pulse rate

Introduction

Physical exercise helps maintain and improve cardiovascular health, which is vital to overall well-being. Due to its cardiovascular advantages, isometric exercise—muscle activation without joint movement—has garnered attention. [1] Isometric exercise raises heart rate, blood pressure, and vascular resistance when contracted. Isometric exercise lowers baseline blood pressure and improves endothelial function, improving cardiovascular health. [2] Medical school generally involves stress and a sedentary lifestyle, which may harm cardiovascular health. Including well-organized exercise programmes in medical students' curricula may be beneficial. Research has demonstrated that even short exercise programmes may improve cardiovascular markers in young people. [3,4] First-year medical students, who are stressed and exercise little, are best for the study. Knowing how isometric exercise impacts this demographic may help you take steps to enhance their physical and mental health during a tough academic period. [5-9] This study addresses the dearth of research on isometric exercise, which has been eclipsed by aerobic or dynamic resistance training. We want to produce considerable data on the health benefits of a six-week isometric exercise training programme for medical students and guide future exercise recommendations by analysing cardiovascular reactivity.

Materials and Methods

This study was conducted in the Department of Physiology, SKMCH, Muzaffarpur, Bihar, India in a period of one year, among 100 untrained first-year medical students, all of whom were pursuing their studies at the time of the study. Participants were divided into two groups: the study group (n=50) and the control group (n=50), both of which were age and sex matched.

Inclusion Criteria:

normotensive students who provided consent to participate.

Exclusion Criteria:

students with anxiety and physical illnesses.

Methodology

Prior to commencing the exercise instruction, initial measures of heart rate and blood pressure were recorded for all participants. Blood pressure was assessed via a Mercury Sphygmomanometer and Stethoscope, while heart rate was documented utilising a fingertip Pulse Oximeter (Oxywatch – Model MD300C2). Measurements were conducted thrice, after a 15-minute period of rest in the supine posture, with each measurement interval being 5 minutes apart. The baseline measurements were collected simultaneously for all patients to reduce diurnal fluctuations.

The isometric exercise training was conducted via a Handgrip Dynamometer. The research group participated in a six-week training programme, attending five training sessions each week. Each training session consisted of four 3-minute intervals of handgrip exercise performed at an intensity of 30% of the participant's Maximum Voluntary Contraction (MVC). There was a 5-minute break between each fight. The MVC, or Maximum Voluntary Contraction, was determined by measuring the highest force produced during three consecutive efforts using the Handgrip Dynamometer. A 10-second break was given between each try to prevent undue tiredness. The grip strength of the hand's small muscle group was assessed.

The training was performed only on the dominant arm while the individual was sitting with the working arm outstretched in front. Prior to each training session, the MVC value was recalculated as the maximum value achieved from three tries, with each attempt being spaced apart by a 1-minute rest period. This training procedure was modified from a previous research.

The control group abstained from any targeted exercise regimen during the duration of the six-week period. They persisted in their regular daily routines and academic pursuits.

Following the six-week training session, heart rate and blood pressure tests were conducted again for both the study and control groups. The same measuring methodology that was utilised for collecting baseline data was adhered to. In addition, handgrip exercise tests were conducted after the training session, where participants were required to exert 30% of their maximum voluntary contraction (MVC) until fatigue. These tests were carried out under the same conditions as the initial baseline tests.

The data were captured and organised using Microsoft Excel. The Statistical Package for the Social Sciences (SPSS) version 16 (SPSS Inc., Chicago, US) was utilised for statistical analysis. A comparative analysis was conducted to evaluate the alterations in heart rate and blood pressure pre and post isometric exercise training in the study group, as well as any disparities between the study and control groups.

Results

Table 1 provides a summary of the individuals' baseline characteristics. The study and control groups had comparable age and gender distributions, and there were no statistically significant differences between them ($p > 0.05$). The initial heart rate and blood pressure data were similar in both groups, suggesting that the groups were evenly matched at the beginning of the trial.

Table 1: Baseline Characteristics of Participants

Characteristic	Study Group (n=50)	Control Group (n=50)	p-value
Age (years)	20.2 ± 1.1	20.4 ± 1.0	0.432
Gender (M/F)	25/25	26/24	0.841
Heart Rate (bpm)	72.3 ± 5.2	71.8 ± 5.5	0.634
Systolic BP (mmHg)	118.5 ± 8.2	119.2 ± 7.9	0.722
Diastolic BP (mmHg)	76.4 ± 5.1	75.9 ± 5.3	0.687

Following the completion of the six-week training session, notable alterations were seen in the research group, as shown in Table 2. The baseline heart rate of 72.3 ± 5.2 bpm reduced to 68.1 ± 4.8 bpm, resulting in a mean reduction of -4.2 ± 1.9 bpm ($p < 0.001$). The systolic blood pressure reduced from 118.5 ± 8.2 mmHg to 112.3 ± 7.6 mmHg, indicating a mean reduction of -6.2 ± 2.4 mmHg ($p < 0.001$). Similarly, the diastolic blood pressure decreased from an average of 76.4 ± 5.1 mmHg to 71.2 ± 4.7 mmHg, resulting in a mean reduction of -5.2 ± 2.1 mmHg ($p < 0.001$).

Table 2: Heart Rate and Blood Pressure Changes in Study Group

Measurement	Baseline	Post-Training	Change	p-value
Heart Rate (bpm)	72.3 ± 5.2	68.1 ± 4.8	-4.2 ± 1.9	<0.001
Systolic BP (mmHg)	118.5 ± 8.2	112.3 ± 7.6	-6.2 ± 2.4	<0.001
Diastolic BP (mmHg)	76.4 ± 5.1	71.2 ± 4.7	-5.2 ± 2.1	<0.001

Conversely, the control group did not exhibit any notable changes in heart rate or blood pressure throughout the same timeframe, as seen in Table 3. The heart rate exhibited a negligible decrease from 71.8 ± 5.5 bpm to 71.4 ± 5.3 bpm (p = 0.527). The systolic blood pressure showed a little decline from 119.2 ± 7.9 mmHg to 118.5 ± 7.6 mmHg, with an average change of -0.7 ± 1.8 mmHg (p = 0.374). The diastolic blood pressure exhibited a little variation from 75.9 ± 5.3 mmHg to 75.7 ± 5.0 mmHg (p = 0.684).

Table 3: Heart Rate and Blood Pressure Changes in Control Group

Measurement	Baseline	Post-Training	Change	p-value
Heart Rate (bpm)	71.8 ± 5.5	71.4 ± 5.3	-0.4 ± 1.2	0.527
Systolic BP (mmHg)	119.2 ± 7.9	118.5 ± 7.6	-0.7 ± 1.8	0.374
Diastolic BP (mmHg)	75.9 ± 5.3	75.7 ± 5.0	-0.2 ± 1.3	0.684

The findings indicate that a six-week isometric exercise training programme had a substantial positive impact on cardiovascular parameters in the participants. Notably, there were decreases in heart rate, systolic blood pressure, and diastolic blood pressure. In contrast, the control group, which did not receive any targeted exercise instruction, did not exhibit any notable alterations in these metrics. The results indicate that isometric exercise training may significantly improve cardiovascular health in first-year medical students.

Discussion

The results of our study showed a significant decrease in both blood pressure and pulse rate among medical students who consistently engaged in isometric handgrip exercise training, in comparison to the control group. The individuals who received training had a significantly diminished hemodynamic response to the isometric handgrip exercise as compared to untrained controls who were of the same age and sex. Research done by Sinoway et al. [10] found that 6 weeks of isometric handgrip training resulted in a decrease in sympathetic nerve activity in the individuals, as evaluated by microneurography. The authors hypothesised that the decline in sympathetic nerve activity was likely a result of a decrease in muscle chemoreceptor activation. Recent research conducted by Mostoufi-moab et al. [11] observed a decline in muscle sympathetic nerve activity, which was accompanied by a decrease in lactate generation during forearm exercise after training. They have proposed that venous lactate functions as a valuable indicator of the generation of metabolic by-products during physical activity. Training may have led to a decrease in metabolite buildup, which in turn resulted in a reduction in sympathetic nerve activity. [12] If this is true, engaging in endurance forearm training might potentially reduce anaerobic metabolism and enhance aerobic metabolism during physical activity. Previous research has shown that assessing muscle sympathetic nerve activity may serve as an indirect measure of chemo-sensitive muscle afferent activation. [13] In separate research conducted by Sinoway et al. [14], it was shown that doing handgrip exercises for a duration of 4 weeks resulted in a specific increase in blood flow in the forearm. This increase was linked to an improvement in the ability of the blood vessels to dilate. The rise in blood circulation occurred due to a reduction in minimum peripheral resistance. This adaptation may potentially explain the diminished blood pressure response seen in our investigation.

Conclusion

Results showed that the research group's cardiovascular parameters improved significantly after the six weeks of isometric exercise training, suggesting that this kind of training programme may improve cardiovascular health. To further corroborate these results, future research might investigate the long-term effects of isometric exercise and how it affects different groups.

References

1. Lässing, J., Maudrich, T., Kenville, R. *et al.* Intensity-dependent cardiopulmonary response during and after strength training. *Sci Rep* **13**,6632(2023). https://doi.org/10.1038/ s41598-023-33873-x
2. Gois MO, Simões RP, Porta A, Kunz VC, Pastre CM, Catai AM. Cardiovascular responses to low-intensity isometric handgrip exercise in coronary artery disease: effects of posture. Braz J Phys Ther. 2020 Sep-Oct;24 (5):449-457. doi: 10.1016/j.bjpt.2019.07.010. Epub 2019 Aug 31. PMID: 31526636; PMC ID: PMC7564016.

3. Azeem K, Zemková E. Effects of Isometric and Isotonic Training on Health-Related Fitness Components in Young Adults. *Applied Sciences*. 2022;12(17):8682. https://doi.org/10.3390/app12178682
4. Millar PJ, McGowan CL, Cornelissen VA, Araujo CG, Swaine IL. Evidence for the role of isometric exercise training in reducing blood pressure: potential mechanisms and future directions. Sports Med. 2014;44(3):345-356.
5. Wiles JD, Allum SR, Coleman DA, James MA. The relationships between exercise intensity, heart rate, and blood pressure during isometric exercise. Med Sci Sports Exerc. 201 7;49(9):1695-1701.
6. Owen A, Wiles J, Swaine I. Effect of isometric exercise on resting blood pressure: a meta-analysis. J Hum Hypertens. 2019;33(2):128-136.
7. Firth J, Solmi M, Wootton RE, Vancampfort D, Schuch FB, Hoare P, Gilbody S, Torous J, Teasdale SB, Stubbs B, Yung AR. A meta-review of "lifestyle psychiatry": the role of exercise, smoking, diet and sleep in the prevention and treatment of mental disorders. World Psychiatry. 2019;18(3):268-278.
8. Cornelissen VA, Fagard RH, Coeckelberghs E, Vanhees L. Impact of resistance training on blood pressure and other cardiovascular risk factors: a meta-analysis of randomized, controlled trials. Hypertension. 2011;58(5):95 0-958.
9. Dyrbye LN, Thomas MR, Shanafelt TD. Medical student distress: causes, consequ ences, and proposed solutions. Mayo Clin Proc. 2006;81(12):1613-1622.
10. Sinoway L J, Shenberger J, Wilson S, Mclaughlin T, Musch, Zelis R. A 30-day forearm work protocol increases maximal forearm blood flow. J. Appl. Physiol. 1987; 62:1063-1067.
11. Mostoufi-moab SE, Widmaier J, Cornett K, Gray, Sinoway L. Forearm training reduces the exercise pressor reflex during ischemic rhythmic handgrip. J. Appl. Physiol.1998; 8 4: 277- 283.
12. Victor RG, Bertocci LA, Pryor L, Nunnally RL. Sympathetic nerve discharge is coupled to muscle cell pH during exercise in humans. J. Clin. Invest.1988; 82: 1301-1305.
13. Clausen JP, Klausen B, Rasmussen, Trapjen sen J. Central and peripheral circulatory changes after training of the arms or legs. Am. J. Physiol**.** 1973; 225: 675-682.
14. Sinoway LJ, Shenberger L, Gretchen *et al.* Forearm training attenuates sympathetic responses to prolonged rhythmic forearm exercise. J. Appl. Physiol. 1996; 81: 1778-17 84